Aviation Week

Including Space Technology

March 10, 1958 75 cents

A McGraw-Hill Publication

How Nose Cone Is Formed for Army Satellite

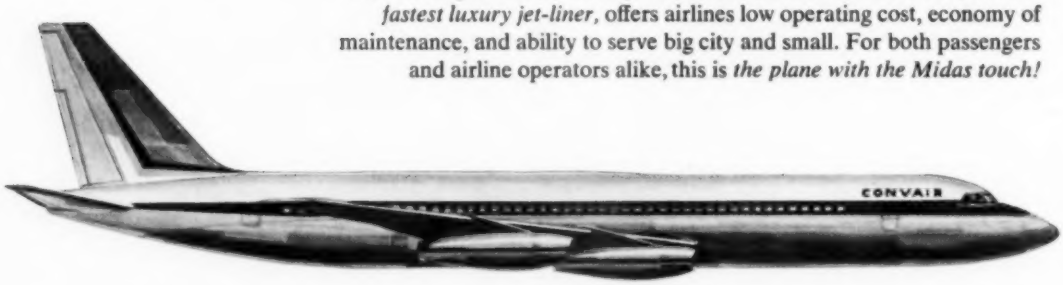
McDonnell F-101B Carries Douglas MB-1 Genies

Fuselage Hoops Resist Fatigue Cracks

CONVAIR JET 880

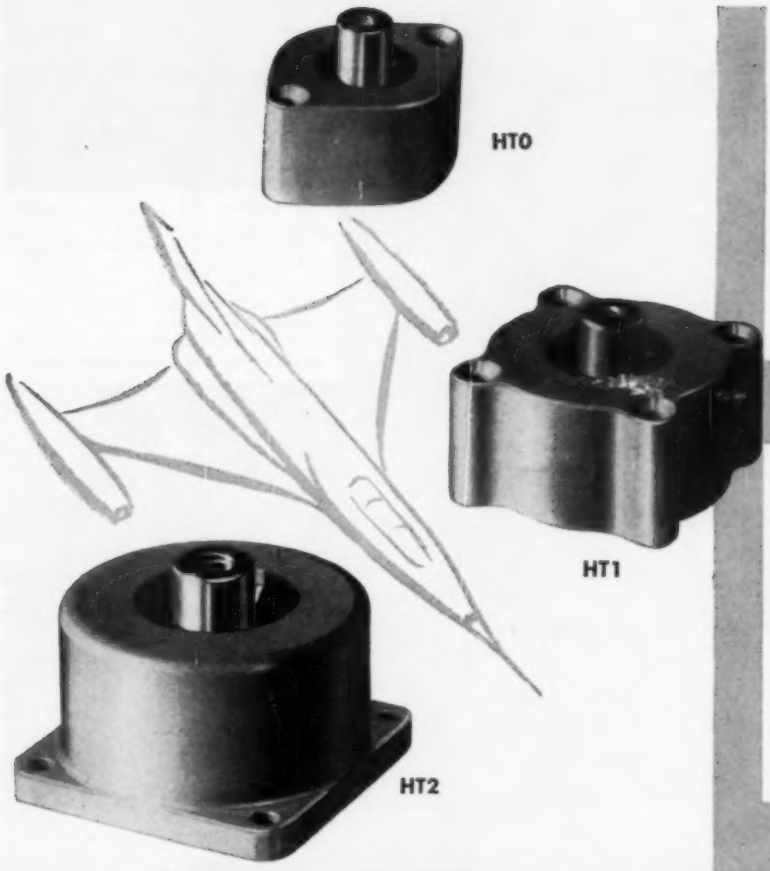
...the plane with the Midas touch

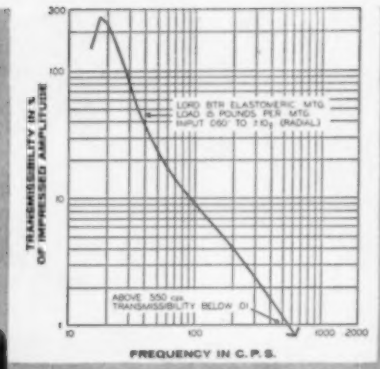
Fit for a king, the Convair Jet 880 has the *golden touch* of regal elegance! With dramatic new interiors, and first class, two-abreast seating throughout...the Convair Jet 880 will bring exciting and exclusive new concepts in travel luxury. In addition, the Convair Jet 880, *world's fastest luxury jet-liner,* offers airlines low operating cost, economy of maintenance, and ability to serve big city and small. For both passengers and airline operators alike, this is *the plane with the Midas touch!*



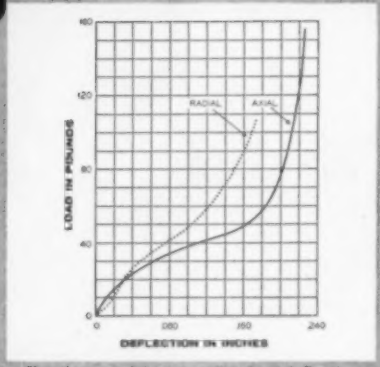
Among airlines to first offer Convair Jet 880 service will be
TWA, DELTA,
TRANSCONTINENTAL, S.A. *(Argentina),*
REAL-AEROVIAS *(Brazil)*

CONVAIR
A DIVISION OF GENERAL DYNAMICS CORPORATION




TRANSMISSIBILITY IN % OF IMPRESSED AMPLITUDE
LORD BTR ELASTOMERIC MTG.
LOAD, 5 POUNDS PER MTG.
INPUT .060 TO 7.0g (RADIAL)
ABOVE 550 cps, TRANSMISSIBILITY BELOW 01
FREQUENCY IN C.P.S.

Transmissibility curve for new Lord BTR Mountings exhibits no discontinuities. Above 550 c.p.s., transmissibility is below 1%.



Non-linear axial and radial load-deflection curves show smoothly increasing shock absorption characteristics of BTR Mountings.

new LORD BTR mountings for airborne electronic equipment

LORD announces a new series of vibration control mountings for the protection of airborne electronic equipment. They incorporate LORD's new Broad Temperature Range elastomer—"BTR"—which combines performance-proved elastomeric advantages with extreme environmental resistance.

BTR Mountings provide excellent all-attitude vibration isolation of frequencies to 2000 c.p.s. under steady-state accelerations and transient shock conditions . . . with no standing waves, distributed system responses or "bottoming". Broad temperature operation is possible since transmissibility and resonant frequency remain virtually constant from −65° to 300°F.

The BTR elastomer combines three functions: load carrying, damping and snubbing. It resists oil and ozone, has high tensile strength, high tear resistance and good flex life.

The new mountings are designed in three basic sizes—HT0, HT1 and HT2—for loads from 3 to 80 pounds per mounting. Specification MIL-C-172B mounting hole configurations provide maximum interchangeability in standard military equipment.

For further details on the new BTR Mountings, consult your nearest LORD field engineer, or contact the Home Office, Erie, Pa.

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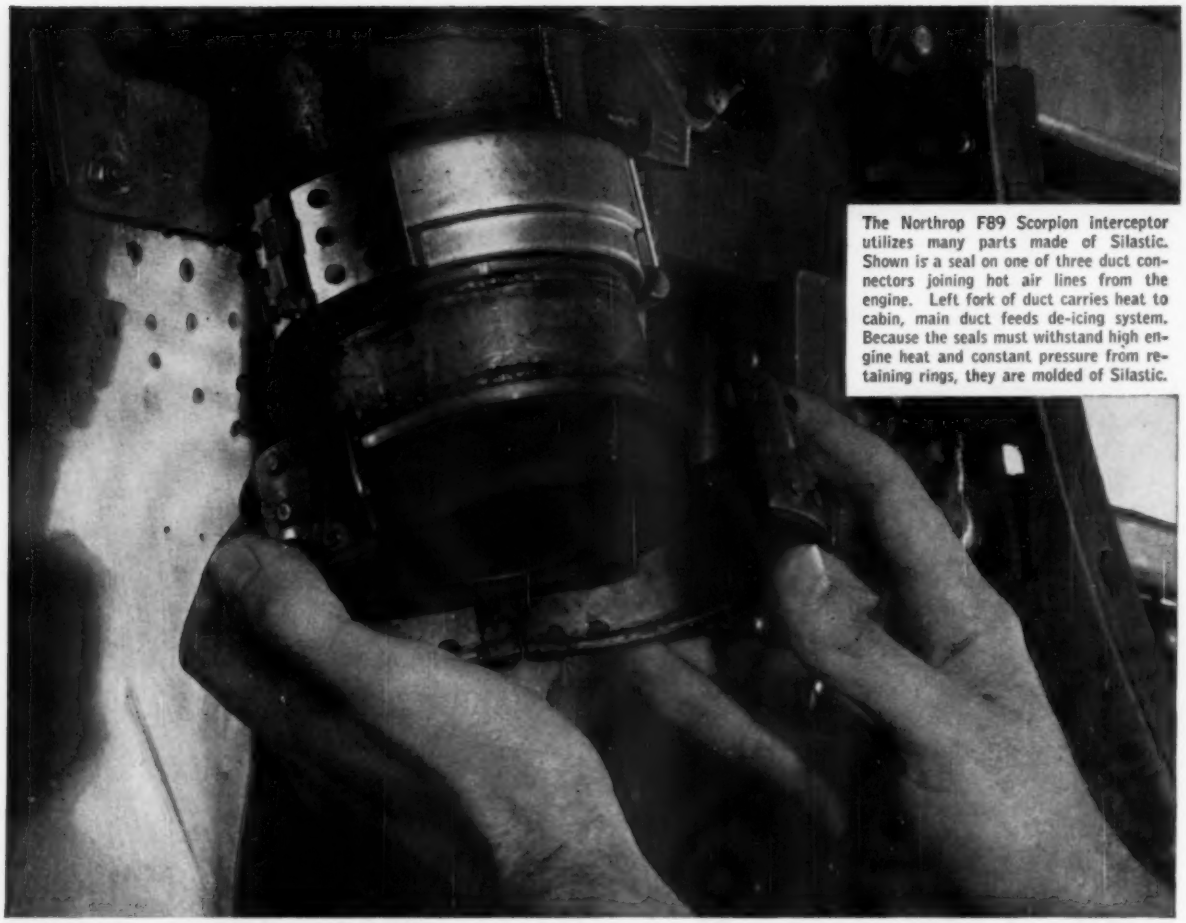

The Northrop F89 Scorpion interceptor utilizes many parts made of Silastic. Shown is a seal on one of three duct connectors joining hot air lines from the engine. Left fork of duct carries heat to cabin, main duct feeds de-icing system. Because the seals must withstand high engine heat and constant pressure from retaining rings, they are molded of Silastic.

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SILICONE RUBBER

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*T.M. REG. U.S. PAT. OFF.

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• Oil resistance	Dependent on type of oil

If you consider ALL the properties of a silicone rubber, you'll specify SILASTIC

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MIDLAND, MICHIGAN

AVIATION CALENDAR

Mar. 13-14—Institute of the Aeronautical Sciences, National Flight Propulsion Meeting (Secret clearance required), Hotel Carter, Cleveland, Ohio.

Mar. 13-14—Second National Conference on Aviation Education, Hotel Mayflower, Washington, D. C.

Mar. 14—Aircraft Production Meeting, Society of Automotive Engineers, Texas Section, Hotel Adolphus, Dallas, Tex.

Mar. 16-20—Joint Aviation Conference, American Rocket Society-American Society of Mechanical Engineers, Statler-Hilton Hotel, Dallas, Tex.

Mar. 17-21—1958 Nuclear Congress, International Amphitheater, Chicago, Ill. Congress includes: Fourth Nuclear Engineering & Science Conference, Atomic Energy Management Conference, Sixth Hot Laboratories Conference, and Atomfair.

Mar. 18-19—Conference on extremely high temperatures (over 30,000K),' sponsored by USAF Cambridge Research Center, L. G. Hanscom Field, Bedford, Mass.

Mar. 18-19—First Inter-Service and Industry Symposium on Guided Missiles Training Equipment (limited to those with Secret clearance), Naval Ordnance Laboratory, White Oaks, Silver Springs, Md. For details write: Mr. J. G. Vaeth, Head of New Weapons & Systems Division, U. S. Naval Training Device Center, Port Washington, N. Y.

Mar. 20-22—1958 Western Space Age Conference and Exhibit, Shrine Exposition Hall, Los Angeles, Calif. Robert Hotz, guest speaker, at noon session Mar. 20. "The Missile Dollar."

Mar. 24-26—Annual Meeting, Aero Medical Assn., Statler Hotel, Washington, D. C.

Mar. 24-27—Institute of Radio Engineers, National Convention, Waldorf-Astoria

(*Continued on page 6*)

AVIATION WEEK Including Space Technology

March 10, 1958
Vol. 68, No. 10

Published weekly with an additional issue in December by McGraw-Hill Publishing Company. James H. McGraw (1860-1948), Founder. Executive, Editorial, Advertising and Subscription offices: **McGraw-Hill Building, 330 West 42nd Street, New York 36, N. Y.** Publication Offices, 99-129 North Broadway, Albany 1, N. Y. Donald C. McGraw, President; Joseph A. Gerardi, Executive Vice President; L. Keith Goodrich, Vice President and Treasurer; John J. Cooke, Secretary; Nelson Bond, Executive Vice President, Publications Division; Ralph B. Smith, Vice President and Editorial Director; Joseph H. Allen, Vice President and Director of Advertising Sales; A. R. Venezian, Vice President and Circulation Coordinator.

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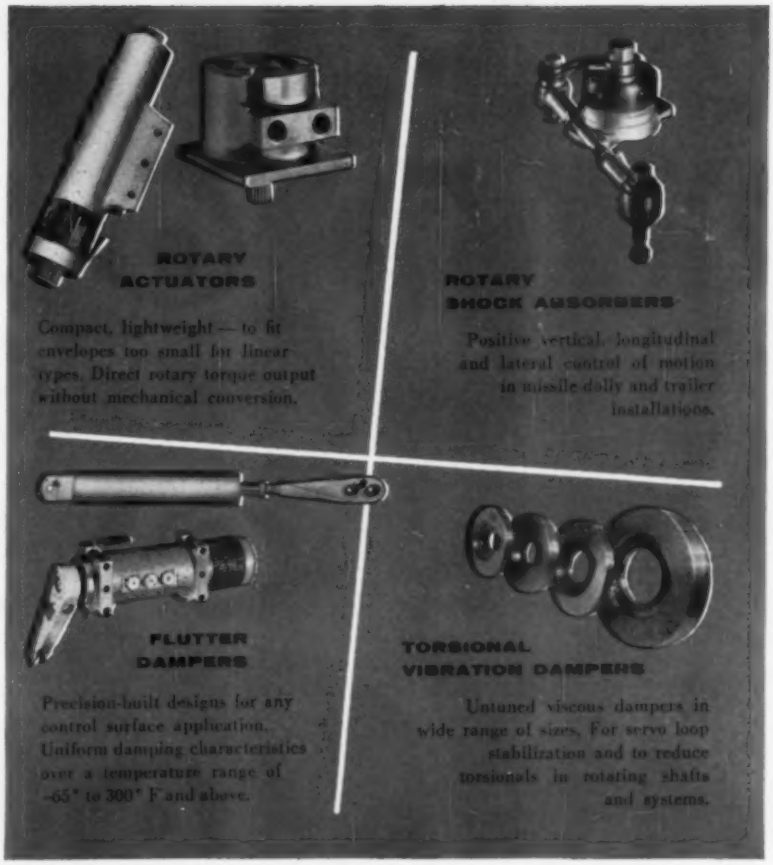
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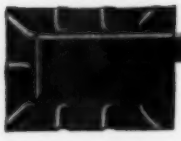
actual size

CEMENT-ON*, Type 1375

The temperature sensing element is encased by a die-formed wire screen which can be installed on any surface with TRANS-SONICS Type 64C cement.

TYPE	TEMPERATURE RANGE
1375A	−300 to +650F.
1375B	0 to 1000F.
1375C	+200 to 1250F.
1375D	+500 to 1550F.

actual size



WELD-ON*, Type 1376

The temperature sensing element is encased in a thin die-formed metal cover, and is installed by spot welding the cover to the underlying metallic surface.

TYPE	TEMPERATURE RANGE
1376A	−300 to +650F.
1376B	0 to 1000F.
1376C	+200 to 1250F.
1376D	+500 to 1550F.

- RANGES: From −400F to +1550F.
- OUTPUT: Up to 5 volts without amplification.
- RESISTANCE CHANGE: 100 ohms over calibrated range.
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- MAXIMUM CONTINUOUS CURRENT: 20 milliamperes rms.
- REPEATABILITY: ±0.2% of range interval.
- VIBRATION: 1-inch double amplitude, 0-22 cps;
  25g, 22-2000 cps.
- ACCELERATION & SHOCK: 100g on all three major axes.
- LEADS: Two 6" nickel wires with high temperature insulation.

Trans-Sonics Cement-On Type 1375 and Weld-On Type 1376 Surface Temperature Transducers are platinum resistance thermometers that can be installed on any surface, flat or curved, metallic or non-metallic, for accurate temperature measurement. The protective cover of the resistive element is cemented or welded directly to the thermal surface to form an isothermal system which gives a transducer reading that corresponds to the true skin temperature.

A 5 point resistance-temperature calibration certificate at 0, ¼, ½, ¾ and full scale temperature is supplied with each transducer. A strip of aluminum Thermotape* is also furnished with each unit to provide an alternate means of tape-on installation useful to 800F and under limited conditions to 1000F.

Types 1375 and 1376 are the newest members of the Trans-Sonics family of platinum resistance thermometers for measuring surface temperatures. All units are capable of delivering up to 5 volts without amplification. Write to Trans-Sonics, Inc., Dept. 7, Burlington, Mass. for Technical Bulletin on Surface Temperature Transducers.

*TRADEMARK

TRANS-SONICS

Precision Transducers

AVIATION CALENDAR

(*Continued from page 5*)

Hotel and New York Coliseum, New York City.

Apr. 8-10—Eighth International Symposia, Electronic Waveguides, Engineering Societies Bldg., 29 W. 39 St., New York City.

Apr. 8-11—National Aeronautic Meeting, Society of Automotive Engineers, Inc., Hotel Commodore, New York, N. Y.

Apr. 10-11—Aeronautical Training Society Annual Meeting, Mayflower Hotel, Washington, D. C.

Apr. 10-12—Southwestern Institute of Radio Engineers Conference and Electronic Show, St. Anthony Hotel and Municipal Auditorium, San Antonio, Tex.

Apr. 16—"Inductive Testing Requirements of Contacts Used in Aircraft Electric Systems," M. Trbovich, Hartman Electrical Mfg. Co., Engineers Club, Philadelphia.

Apr. 16-19—14th Annual National Forum, American Helicopter Society, Sheraton-Park Hotel, Washington, D. C.

Apr. 17-18—Institute of Environmental Engineers, Second Annual Technical Meeting, New Yorker Hotel, New York City.

Apr. 22-24—1958 Electronic Components Conference, Ambassador Hotel, Los Angeles, Calif.

Apr. 22-24—1958 Annual Convention, International Airline Navigators Council, Piccadilly Hotel, New York, N. Y.

Apr. 28-30—Second Annual Astronautics Conference, sponsored by Air Force Office of Scientific Research and Institute of Aeronautical Sciences, Shirley Savoy Hotel, Denver, Colo.

May 1-8—26th Annual Meeting, American Society of Tool Engineers, Philadelphia Convention Center, Philadelphia, Pa.

May 4-7—Fourth National Flight Test Instrumentation Symposium, Park Sheraton Hotel, New York City.

May 12-14—National Conference on Aeronautical Electronics, sponsored by Institute of Radio Engineers, Biltmore Hotel, Dayton, Ohio.

May 14-16—Spring Meeting, Society for Experimental Stress Analysis, Hotel Manger, Cleveland, Ohio.

May 19-22—17th Annual National Conference, Society of Aeronautical Weight Engineers, Inc., Belmont Plaza Hotel, New York, N. Y.

June 2-4—1958 National Telemetering Conference, Lord Baltimore Hotel, Baltimore.

June 9-13—Fourth International Automation Exposition and Congress, Coliseum, N. Y., N. Y.

June 24-26—31st Meeting, Aviation Distributors and Manufacturers Assn., Mount Washington Hotel, Bretton Woods, N. H.

June 25-27—Air Transportation Conference, sponsored by American Institute of Electrical Engineers, Hotel Statler, Buffalo, N. Y. For information: S. H. Hanville, Jack & Heintz, Cleveland 1, Ohio.

Sept. 1-7—1958 Farnborough Flying Display and Exhibition, Society of British Aircraft Constructors, Farnborough, England.

Sept. 6-14—International Aviation Show, Coliseum, New York, N. Y.

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Firestone Tires qualify as original equipment on new Boeing 707 Jetliner

Like most everything about the sleek, new Boeing 707, new kinds of tires were called for, new tire specs had to be written. To get the safest, most dependable tires that could be built Boeing accepted recommended qualification tests set up by the Tire and Rim Association. Tire engineers carefully reviewed the requirements and decided that dynamic testing at 200 m.p.h. was necessary to assure maximum safety. All tire manufacturers had to meet or exceed these specifications to qualify.

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Firestone is proud to have been accepted as one of the companies supplying tires for the new Boeing Jetliners—proud of the part they have been assigned in ushering in this wonderful, new age of faster, safer, more comfortable air transportation.

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▶Solids Senior rockets developed for Polaris, infrared homing for guidance are key features of proposal to USAF.

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▶Fact finding board's decision would set precedent for jet-age negotiations between carriers, crews.

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▶Blunt stainless steel unit has high tensile strength; resists corrosion and temperature extremes.

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EDITORIAL

Stagnation on Space?

Aerojet's five stage Moon rocket proposal to the Air Force, details of which are revealed on page 18, is another example of how the aviation industry has responded to the Soviet challenge in useful space exploration. Aerojet's proposal, like so many others now gathering Pentagon dust, is based on an ingenious combination of well-developed missile propulsion and guidance systems. But the real missing link in getting the Aerojet and other aviation industry proposals off the ground and into space is the lack of top level Pentagon decisions.

We are now well into the sixth month since the Soviet's Sputnik I shattered our technological superiority complex. With the exception of the unleashing of the Army's Jupiter C launched Explorer satellite program, literally nothing has been done to get a United States national space program under way. There has been a noticeable slacking off of Congressional interest in space since the spectre of a major economic recession was raised last month.

Layer Upon Layer

In the Pentagon top level efforts have been devoted primarily to creation of a new layer of super-bureaucracy in the research and development picture and an inter-service struggle for the major space missions. Although the Army's failure with the second Explorer has knocked some of the gilt from the super-scientist halo worn by the Redstone arsenalists, they are making a strong political move to turn Huntsville into the major space research center. This is despite the fact it is almost completely lacking in every type of facility required except good technical manpower.

There is also another strong political drive emanating from the advisory group organized by James Killian, the President's scientific aide, to inflate the Pentagon's Advanced Research Projects Agency into a super agency that will control all military research programs and provide a bright new empire for some power-hungry scientists whose bent lies more toward political maneuvering than solid technical achievement. There is also an extremely dangerous trend on the part of some Air Force leaders to divest this service of all its research activities and toss them to ARPA. What reasoning lies behind this madness is not clear at the moment except that there has always been a strong group within the Air Force that has never fully understood the real implications of a research program in terms of this service's future. They have bitterly resented the rise of the technically literate officer in the USAF hierarchy.

Development Over Research

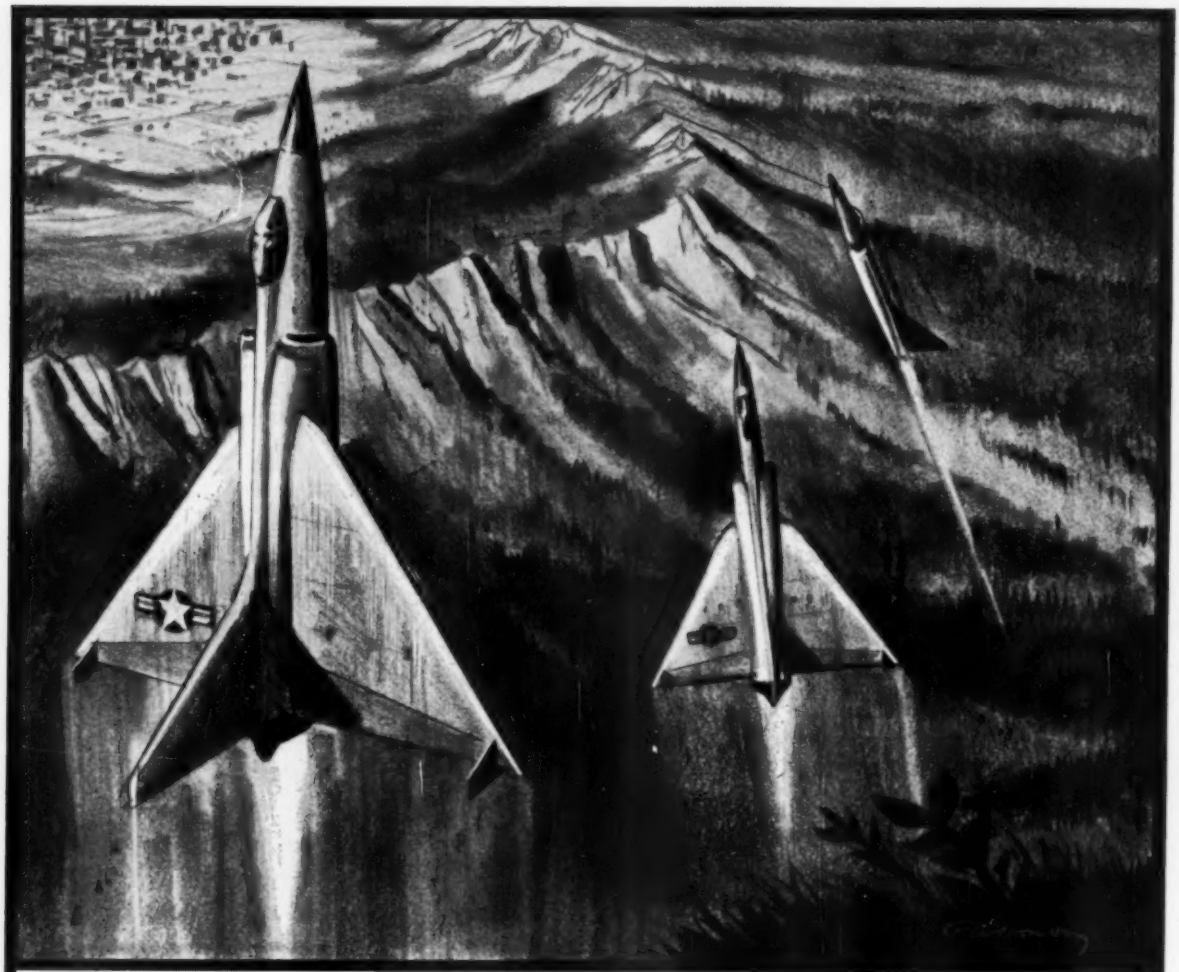
The research mission even in Air Research and Development Command, except for a brief period several years ago before the budget ax descended, has been a badly treated orphan in contrast to the emphasis on the development phase. We have detailed previously on this page USAF efforts to organize and operate an effective space research program and strangulation of these efforts by Donald Quarles and Charles E. Wilson. We can certainly understand the frustration of USAF leadership at having their soundly conceived plans for space exploration vetoed two years ago and now being told that a brand new agency must be established to do the space job they tried so hard to do earlier. Suddenly to abandon its research mission for political appeasement or for some role-and-mission horse trading would eventually be suicidal for the Air Force or any other service.

Significant Struggle

The struggle now going on inside the White House, Pentagon and on Capitol Hill over how, by whom and when a national space program will be organized is one of the most significant of modern history. It will not only determine whether this nation will play a dominant role in the vital exploration of space. It will also determine whether this nation can effectively organize a truly national program fully utilizing the scientific ability and the industrial capacity available to maintain a position of international leadership or whether we will continue to stumble along without positive direction, hamstrung by bureaucracy and stifled by technical timidity.

At the moment the outlines of how this policy is developing are still too dim for evaluation. Only one thing is certain. We are still wasting precious time.

—Robert Hotz



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WHO'S WHERE

In the Front Office

R. W. Rummel, chairman, and **R. K. Rourke**, deputy chairman, Trans World Airlines' Jet Planning Committee. Mr. Rummel is TWA's vice president-engineering, and Mr. Rourke is director of engineering research.

Leonard Kelsey Schwartz, a vice president, Hughes Tool Co., Los Angeles, Calif.

Henry Lehne, vice president, Sylvania Electronic Systems, division of Sylvania Electric Products, Inc., New York, N. Y.

David R. Hull, vice president-defense programs, Raytheon Manufacturing Co.

William G. Fallon, a vice president, director and executive board member, Norton Co., Worcester, Mass.

Dr. Barry G. King, vice president-life sciences, Operations Research, Inc., Silver Springs, Md. Also: **Robert Bicknell**, executive vice president, a director.

Dr. James Hillier, vice president, RCA Laboratories, and **Joseph M. Hertzberg**, vice president, Defense Marketing, Defense Electronic Products, Radio Corporation of America, New York, N. Y.

Burton Schellenback, vice president-sales, H. K. Porter Company, Inc., New York.

Henry W. Held, U. S. vice president, Irish Airlines-Aerlinte Eireann.

William M. Dunn, Jr., vice president-traffic and sales, and **M. K. Williams**, vice president-operations, ASA International Airlines.

Jere T. Farrah, assistant vice president-engineering, Seaboard & Western Airlines.

Jack S. Warshauer, executive vice president and chief executive officer, Summers Gyroscope Co., Santa Monica, Calif. Also: **Robert E. Peck**, vice president-operations.

George B. Gelly, vice president-marketing, Hoffman Laboratories Division, Hoffman Electronics Corp., Los Angeles, Calif.

Alfred S. Walker, vice president-services, Northeast Airlines, Inc. Also: **Joel S. Daniels, Jr.**, assistant vice president-advertising and promotion.

W. C. Whitehead, president, Aerol Associates, division of Cleveland Pneumatic Industries, Inc., Cleveland, Ohio.

Honors and Elections

Carlyle S. Fliedner, Bureau of Aeronautics' senior power plant engineer, has been awarded the Navy's highest civilian honorary award, the Distinguished Civilian Service Award, "for distinguished performance . . . and for exceptional service. . . ."

T. E. Tillinghast, retiring president of The United Aircraft Service Corp., will receive the Gen. William E. Mitchell Award at the annual dinner on April 9. The Award will be presented by Gen. Edwin W. Rawlings, Commanding General of the Air Materiel Command.

Brig. Gen. Marvin C. Demler, ARDC Deputy Commander for Research and Development, has been elected a Fellow of The Institute of the Aeronautical Sciences "for outstanding contributions in the field of aeronautics."

(Continued on p. 85)

INDUSTRY OBSERVER

► Firing tests of the Douglas MB-1 Genie atomic air defense missile from Lockheed's F-104 Starfighter are scheduled to begin this month. Seventy missiles, without warheads, will be fired during the tests.

► **Flight test program has begun on full-scale prototype of Piasecki Aircraft Corp.'s Sea Bat VTOL developed under Navy contract. Sea Bat is an unmanned remotely controlled rotary wing drone designed for operation from surface ships and submarines. Indications are that control is provided electronically to an autopilot.**

► Sophisticated versions of present pilot displays will be adequate for X-15-class research vehicles. No need for additional frames of reference for pilot displays are foreseen for the X-15 and its limited penetrations of space.

► **Hughes Aircraft Co. is developing the fire control and cockpit displays for the system on North American's F-108 long-range interceptor.**

► New device that would automatically warn a pilot with light or sound that he is falling asleep may be developed from a new skin resistance meter now being used by Wright Air Development Center's Aero Medical Laboratory to keep track of the activities of subjects undergoing prolonged isolation tests. Sleep warner might be particularly useful on long space flights. Heart of the system is a newly developed, electrically conductive cloth that is held against the soles of a man's foot by his socks. Method is more comfortable than previous practice of inserting fine wires subcutaneously to pick up the minute electrical currents required for the meter's operation.

► **Jupiter intermediate range ballistic missile has been given a Strategic Missile number designation by USAF, which will use the Army-developed missile. Designation is SM-78.**

► Brantly Helicopter Corp. has set a price of $19,950 on its two-place all-metal B-2 now in production at Frederick, Okla. Price includes radio and omni navigation equipment. Current schedule calls for production of 17 B-2s, 12 for civilian use, the remainder for the Army. Initial deliveries of the military model are planned for next year.

► **Air Force is buying four separate versions of Republic Aviation Corp.'s F-105. F-105B is a single-seat day fighter-bomber. F-105D is a single-seat all-weather fighter-bomber. F-105E is a two-place all-weather fighter bomber. JF-105B is being used as a test vehicle for systems components, reflects a change from original mission of photographic reconnaissance to other reconnaissance methods.**

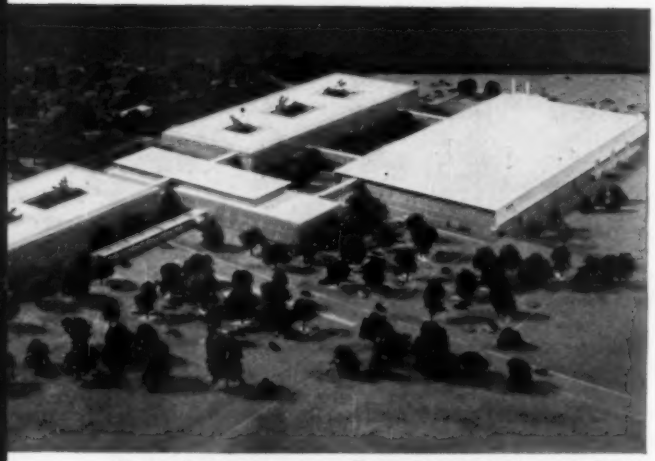
► High-vacuum electron gun is being used by Temescal Metallurgical Corp., Richmond, Calif., to melt metals and other solid materials. Navy says this provides improvement over other devices by a factor of at least 10. Niobium ingots 1.5 in. in diameter and 1 ft. long are being drawn at a rate of 80 in., or 40 lb., per hour. Under Office of Naval Research contract, company is exploring use of the technique to melt refractory metals such as molybdenum, tungsten and tantalum to remove non-metallic impurities.

► **Full-scale test bed of Piasecki Aircraft Corp.'s ring wing VTOL sponsored by Navy has completed ground tests; company is now conducting a wind tunnel investigation of a model. Basic configuration is that of a ring embodying an airfoil. Propulsion is by means of a ducted fan.**

► Boeing Bomarc interceptor missile flys on its back after vertical launch until the main ramjet engine cuts in. Then the missile flips over into normal flight position.

► **Lockheed is telling prospective European buyers of the F-104 that the supersonic fighter can carry five external stores under the wings and fuselage as a fighter-bomber. Current comparison being made with the Swiss P-16 attack plane in sales drive claims the F-104 can carry the same load with improved speed performance.**

Dennis W. Holdsworth



Pictured above is our new Research and Development Center now under construction in Wilmington, Massachusetts. Scheduled for completion this year, the ultramodern laboratory will house the scientific and technical staff of the Avco Research and Advanced Development Division.

Avco's new research division now offers unusual and exciting career opportunities for exceptionally qualified and forward-looking scientists and engineers.

Write to Dr. R. W. Johnston, Scientific and Technical Relations, Avco Research and Advanced Development Division, 20 South Union Street, Lawrence, Massachusetts.

IDEALS AND PRACTICALITY

"Science and Philosophy mutually criticize each other and provide imaginative material for each other."... Alfred North Whitehead.

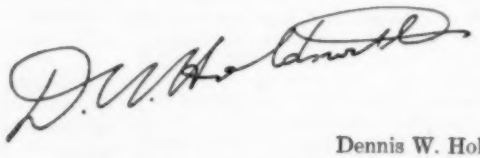
In the increasing preoccupation of science with material things and progress, the truth of this statement by one of our greatest philosophers is often overlooked and forgotten. The scientific philosopher is a rare being and is becoming rarer still, nor can he be adequately replaced by the group technique or the 'brainstorm' session.

It should be one of the noblest aspirations of all our sciences to provide for the true contemplation of the inner meaning of facts and to stimulate that interplay of mind on mind by which alone we may progress.

In all these things, however, we cannot forget the problems peculiar to research and development in private industry. The obligation to work to otherwise-determined time-scales poses a nice problem in balancing ideals against the practicalities of everyday life.

It is in this field that the test of management comes. Its success at meeting such continuously conflicting requirements determines the character and ultimate success of the organization.

With such thoughts as these in mind, we here at Research and Advanced Development Division of AVCO are seeking unique people. We wish to foster the creative minds and fundamental thinkers, while preserving an atmosphere of self-discipline, free from a rigid hierarchy of command and organization.



Dennis W. Holdsworth,
Manager, Computer and Electronic Systems Department

AVCO
Research & Advanced Development

Washington Roundup

Bridges Attacks ARPA

Sen. Styles Bridges (R., N. H.) warned Defense Secretary Neil H. McElroy last week that the Advanced Research Projects Agency should stick to policy and not become an operating space agency. He said Congress had established the single-manager agency for space and satellites as a policy-making agency and not to produce hardware for the military services.

Meanwhile, ARPA Director Roy W. Johnson named Rear Adm. John E. Clark, director of the Navy's guided missile division, as his deputy director. Adm. Clark will leave his Navy post. Johnson also appointed Lawrence P. Gise, former assistant director, Military Applications, Atomic Energy Commission, as director of program control and administration, and Lambert L. Lind of Ebasco Services, N. Y., as special assistant director.

And, in the House, Rep. Peter Frelinghuysen (R., N. J.) introduced a bill to give the National Advisory Committee for Aeronautics control of all space projects for both civilian and military application. The bill would increase the scope of NACA's activities and add astronautics to the agency's name.

Transportation Tax Repeal?

The economic decline has brightened the outlook for repeal of transportation taxes of 3% on freight and 10% on passengers. Members of Senate Commerce Committee are now pushing for repeal. Sen. George Smathers (D., Fla.), a member of the commerce committee and the tax-deciding Senate finance committee, makes these points:

- **Small businessmen would particularly benefit** because they cannot easily provide their own transportation.
- **Net revenue loss would not exceed** $325 million because much of the tax is now deductible business expense. By stimulating business, repeal would result in a net revenue gain.

Yield vs. Fare Increase

A Northeast Airlines move to hike its passenger fares even higher than the rate reached as a result of the 4% plus $1.00 increase authorized last month has been suspended for investigation by the Civil Aeronautics Board on grounds that the carrier's yield is already the highest in the trunkline industry. Northeast proposed to increase first-class passenger fares between a number of points by $1.00 because it had not added a dollar to each ticket cost in 1952 when the board permitted all domestic lines to make such an adjustment. The board, however, took a dim view of the proposal and noted that the boost could bring the yield from one segment of the airline's routes to as high as 11.5 cents per passenger mile. The board said Northeast's present average yield of 7.25 cents per passenger mile is "by far" the highest of any trunk carrier.

Soviet Atom Plane Victory?

Air Force Secretary James H. Douglas says the Soviets may well fly a nuclear-powered aircraft ahead of the U. S. because of a Defense Department decision four years ago not to try to fly an atomic plane at the earliest date. Instead, Defense decided to concentrate on reactors and engines until a useful weapon system was obtained.

Douglas added in testimony before the House Appropriations Committee that, if the Russians have the objective of being able to say, "We can fly a nuclear-powered airplane," they may be a lot closer to it than the U. S. He said, however, that "stepped-up" activity of the U. S. project has been recommended.

Douglas told the committee that, from 1946 through 1958, the total cost of the program to the Air Force, Navy and Atomic Energy Commission has been $692,030,000. He said the General Electric Co. reactor and engine will be ready to run within the near future but that, unless a "fly-early" plan is adopted, the first flight may still be six or seven years away.

Space and Recession

Sense of urgency to push defense programs—particularly outer space and missiles—that prevailed in Congress at the opening of the session in January has shown some decline. Recession and the domestic economy are dominating political speeches.

House didn't get around to appointing its Special Committee on Astronautics and Space Exploration until last week. The committee is a counterpart of the Senate special committee headed by Sen. Lyndon Johnson (D., Tex.), Senate majority leader, and has been given until next Jan. 3 to report its findings.

Rep. John McCormick (D., Mass.), House majority leader, is chairman, and Rep. Joseph Martin (R., Mass.), minority leader, is ranking Republican. Other members of the group are:

Democrats: Rep. Overton Brooks (La.), Brooks Hays (Ark.), Leo O'Brien (N. Y.), Lee Metcalf (Mont.), William Natcher (Ky.), B. F. Sisk (Calif.).

Republicans: Leslie Arends (Ill.), Gordon McDonough (Calif.), James Fulton (Pa.), Kenneth Keating (N. Y.), Gerald Ford (Mich.).

Durfee Warning

Civil Aeronautics Board Chairman James R. Durfee has served notice on Congressmen that expanded local airline service in their respective areas goes hand-in-hand with additional appropriations to support that service. Closing the hearings in the Seven States Area Case with a pointed lecture on subsidy, Chairman Durfee noted that no congressman had appeared before the Board to suggest a discontinuance or narrowing or local airline service for the sake of economy. Rather, he said, every senator and representative who testified urgently pleaded for an expansion of service. He suggested that the amount of additional service in the case recommended by the examiner would entail a subsidy of about $2¼ million and warned that the field of local service operations will continually require a heavier subsidy burden if service is increased. Durfee chose an appropriate time to make his point. The Seven States Area Case was notable because of the unusually large number of members of Congress and representatives of state aeronautical agencies who appeared before the Board to ask for more service for their constituents. —**Washington staff**

Space Technology

Aerojet Designs 5-Stage Moon Vehicle

Solid Senior rockets developed for Polaris, infrared homing guidance are features of proposal to USAF.

Washington—Aerobee M, Aerojet-General Corp.'s Moon rocket proposal to the Air Force, is a five stage solid propellant vehicle making use of Aerojet's Senior rockets developed for Navy's Polaris and a simple terminal guidance system with an infrared scanner.

The proposal was referred to briefly in a speech by Aerojet President Dan A. Kimball to the New York Society of Security Analysts. He said only that the company believed it could put the rocket in orbit around the Moon in a reasonably short time. AVIATION WEEK later learned details of the proposal.

Simple Launcher

Projectile would be fired from a special simple ground launcher in a ballistic trajectory at a calculated time to ensure that it will reach the general area of the Moon's orbit at a period when the Moon would be at a predetermined point in that vicinity.

Terminal guidance would be in the form of an infrared scanner for controlling two final solid-propellant rockets—the first a retrorocket for deceleration, the second a directional (steering) rocket—which remains with the nose payload of instruments and transmitter.

When the rotating projectile reaches the general plane of the Moon's orbit, the scanner "sees" the Moon, ignites the retrorocket to slow the projectile's speed in its radial path from Earth. Steering rocket, oriented at the proper angle, is fired to direct the projectile for impact on Moon or to achieve lunar satellite velocity around the Moon, depending upon the mission projected. Orbit around the Moon would furnish data on the unseen far side, magnetic field, Moon topography, and meteorite distribution, size and speed in the vicinity of Moon.

Scanner and associated components which cause ignition of the solid and directional rockets might weigh about 10 lb.

Exclusive of this guidance, the payload of instruments and transmitter probably would weigh about 25 to 35 lb.

There is ample heat for infrared detection when the Moon is getting direct rays of Sun. This is true also when the Moon is dark against the relatively cold background of space.

No initial guidance system is used to put the projectile into ballistic trajectory. To fire the vehicle in this aiming trajectory to intercept the Moon will be a difficult thing to do, but is theoretically possible.

The Aerobee M proposal contemplates various speed conditions to achieve various orbit distances around the Moon. This would simply be a matter of orienting the directional rocket in proper angle and giving it desired thrust.

Spin imparted to the vehicle in ground launch, plus the vehicle's aerodynamic stabilization, is considered sufficient control to get it at a spot relative to the Moon where the terminal guidance can take over to insure impact or satellite orbit around the Moon.

Solid Rockets

All rocket motors for Aerobee M would be Aerojet solid propellant units. Excluding the final two rockets associated with terminal guidance, the projectile is a five-stage configuration:

- **First stage** is a cluster of four Aerojet Seniors, as developed for Polaris intermediate range ballistic missile. Propellant for this stage is polyurethane plus oxidizer, with a specific impulse which may be as high as 270. It is probable that this fuel would be used in all the rocket motors of the Moon vehicle.

During first stage burning, spin rockets would impart rotation for stabilization.

- **Second stage** is a single Aerojet Senior.
- **Third stage** is a single Aerojet Junior, which has been brought along during development of the Senior rocket motor.
- **Fourth stage** is a cluster of four Aerojet rockets similar in thrust and duration to the Vanguard third stage (Grand Central Rocket Co. unit).
- **Fifth stage** is a single rocket of this type.

Proposal, made early in January, anticipates that cost of project would be about $30 million. This would include development program for instrumentation and guidance, static and flight tests of individual rocket stages, checkout of burning time and separation techniques.

Under present planning, Aerobee M might be ready for final, operational

USAF Views New Space Ship

Krafft Ehricke (left), Convair Astronautics division chief space planner, demonstrates principles of a new solar powered manned space vehicle to Lt. Gen. C. S. Irvine (right), USAF deputy chief of staff for materiel, and his assistant Maj. Gen. Mark Bradley (holding a space station model) and Maj. Gen. C. J. Bondley, director of supply and services. Ehricke's conference with Gen. Irvine and his materiel staff in the Pentagon indicates USAF interest in practical approaches to military space mission.

shoot within one year, sooner if priority support were given the program.

Although Kimball, in his New York talk, referred to the Aerobee-Hi rocket as capable of putting a small man into space, no manned applications are visualized in the Aerobee M project.

Data gained in the Moon shot would be transmitted back to Earth by telemeter.

USAF itself has proposed a Moon shot using a Thor intermediate range ballistic missile with a solid propellant second stage drawn from Vanguard project components (AW March 3, p. 330).

A solid propellant second stage could be added to Thor within a year, Air Force Secretary James H. Douglas said in testimony released by the House Appropriations Committee last week. The second-stage probably would be used in connection with USAF's reconnaissance satellite program.

He said a solid propellant second stage that would be available within this time would be a relatively small rocket stage of 5,000 to 10,000 lb. thrust.

ARDC Centralizes Nuclear Developments

Washington—Central administrative control and a single funding source to speed Air Force nuclear research and development programs will be provided by a new office within the Air Research and Development Command. Unit, which has been designated the Office of the Assistant for Nuclear Programs, will be headed by Col. John H. de Russy.

The office supersedes the ARDC's Directorate of Nuclear Systems at Wright Field which was concerned with only the WS-125A nuclear aircraft project. Now all aircraft, satellites, missiles and space vehicles that are powered by nuclear engines will come under Col. de Russy's cognizance. His office will serve as a central contact for all contractors and a clearing house for all funding of ARDC nuclear programs.

While Col. de Russy's office will facilitate the development contractor's working level contact with ARDC, the life cycle of a nuclear project is otherwise unchanged.

Congress, Department of Defense, the Atomic Energy Commission and the Air Force all have control over the conception and birth. The Atomic Energy commission and the Air Force then must combine and coordinate the project's development into an operational weapon system with defense exercising veto power. The AEC handles reactor development and the Air Force oversees the design and construction of the airframe.

Army Launches Explorer II; Orbit May Have Been Missed

By Evert Clark

Cape Canaveral, Fla.—Army's Explorer II satellite apparently failed to go into orbit last week after what appeared to be a successful firing from Air Force's Missile Test Center.

Although some officials still held hope late last week that the 80-in. 32.47 lb. Explorer II might have attained orbit, Dr. William H. Pickering, director of California Institute of Technology's Jet Propulsion Laboratory, said "there is every indication that the satellite did not function normally and there is a great probability that it is not in orbit." JPL and Army Ballistic Missile Agency are joint developers of the project.

Preliminary investigation showed probable cause of the failure was the failure of the last stage of the four-stage rocket to fire.

Dr. Pickering and Dr. Albert R. Hibbs, chief of JPL's research analysis section, said "the preliminary evidence is that the last stage did not produce any thrust. This means it did not get up to velocity . . ."

However, the final key as to just what did happen to the satellite after it was detected by at least one tracking station may have to await extensive data reduction of the information available. Dr. Pickering said it would require several days at least to complete evaluation of the data.

Other officials said the satellite vehicle may have pitched slightly upwards from the parallel position needed to attain a successful orbit.

Primary difference between the instrumentation of the successful Explorer I (AW Feb. 10, p. 29) and Explorer II was a small tape recorder designed to condense its experience with cosmic rays. The recorder then would then transmit the information on signal as it passed over a telemetering station.

The cosmic ray instrument package, which could play back in six seconds information gathered in one orbit, was the same one suggested by Dr. James van Allen of Iowa University for Navy's Vanguard program in which cosmic ray readings from a Geiger-Mueller tube are stored on the tape.

Low power transmitter was 10 milliwatts, using a 108 mc frequency. High power transmitter was 60 milliwatts at 108.03 mc.

Cosmic ray readings would be in terms of incidence as a function of time.

Only rays of a certain frequency or above would penetrate Explorer II's steel case and pass into the counter. After 32 triggerings, modulation frequency changes. After another 32, it changes back to the original setting. Each change in modulation frequency is stored on tape, and it is these changes that would be transmitted to Earth.

The tape was designed to erase as it plays back and would be ready to store new information after each orbit.

Launch angle was equal to a 34½ deg. declination at the equator. Army preferred a more southerly heading to widen the area covered by Explorer's path but, in both launchings, range safety and geographical location of the Missile Test Center's tracking stations dictated the angle.

Officials last week declined to speculate as to what may have happened to the Explorer II vehicle if orbit was not achieved. It was believed, however, that it probably would have reentered the atmosphere rather than drifting on into space.

Explorer I is now believed to be moving through space in propeller fashion, spinning like a pinwheel. Originally, it pointed forward and spun about its longitudinal axis like a rifle bullet. But dynamic coupling of inertial forces gradually has put it into this new attitude, Jet Propulsion laboratory scientists believe. Theory was developed after "interesting amplitude modulations" were received from the satellite's transmitters.

Apogee of the first satellite is now about 1,587 mi.; perigee about 217 mi. Period of rotation about the earth is approximately 114.7 min.

Newest theory on why Explorer I's high-power transmitter quit once and later began transmitting again is that the batteries weakened as expected but did not completely lose power and "a rather curious electronic phenomenon took place" that allowed it to transmit intermittently power remaining.

As the second satellite was launched, the low-power transmitter in the first was still working; the high-power transmitter still worked occasionally.

JPL scientists have found that shorting out the emitter battery pack in the laboratory caused transmission after battery power was low. They believe this may be what is happening in the first satellite.

Explorer I already has demonstrated that space is habitable for man. Extremes of temperature inside the steel cased satellite are 6C to 30C. And at least some scientists agree the cosmic ray energy level is not hazardous.

Industry Faces Government-Facility Tax

Washington—Fewer orders for hardware, higher rental fees for government-owned facilities or increased defense budgets to meet the new costs may result from a broad Supreme Court tax decision handed down last week.

Specifically, the new ruling—which in some aspects reverses 150 years of legal precedent—declares:

• **All government-owned plants** leased or used by private contractors are subject to state or local real property taxes at full value.

• **All government-owned materials**—raw materials, parts, durable and nondurable tools and inventories, work in process, etc.—held by government contractors are subject to state or local personal property taxes.

Who Pays

In both cases, the taxes levied are payable by the contractor but, since they are allowable costs under defense contracts, the federal government will be forced to carry most of the burden.

One Defense Department official said that, if state and local tax officials make the expected rush to take advantage of the ruling, it will cost the Defense Department hundreds of millions of dollars annually. It can meet these new costs, he said, only by asking Congress for more money or by cutting back on future orders.

The Defense Department also might soften the blow, he said, by raising the rentals on government-owned facilities.

As an indication of possible costs involved, 12 major aircraft companies have facilities for aircraft and related production valued at a combined total of $1,280 million, without depreciation. Of this, the companies own approximately one-third; the government two-thirds.

The privately-owned facilities of these companies and others always have been subject to local taxation.

Another indication is the still disputed levy by Los Angeles County, Calif., on government-owned inventory, work in process and productive equipment (AW July 8, p. 28). Last year, this tax brought the county approximately $22 million from defense contractors.

Although the Los Angeles tax was not specifically involved in last week's decision, the ruling virtually ends Defense Department hopes of having it rescinded.

The case now is being appealed by Los Angeles County to the California Supreme Court following a lower court decision that such taxes are illegal.

Three Test Cases

The three test cases that led to the Supreme Court decision all involved Michigan facilities:

• **Murray Corp.** protesting, with the federal government, personal property taxes levied by the City of Detroit and Wayne County, Mich. The city and county applied the tax to all parts, materials and work in process acquired or used by Murray in working on subcontracts for aircraft parts.

Murray and the federal government protested that the tax violated government immunity from state taxation. The Supreme Court, however, denied the plea by a close five-four decision.

• **Borg-Warner Corp.** and Continental Motors Corp. protesting local taxes on federal real property. Under a 1953 state law, a private party is subject to taxation to the same extent as though he owned the property if normally tax-exempt real property is used in a business conducted for profit.

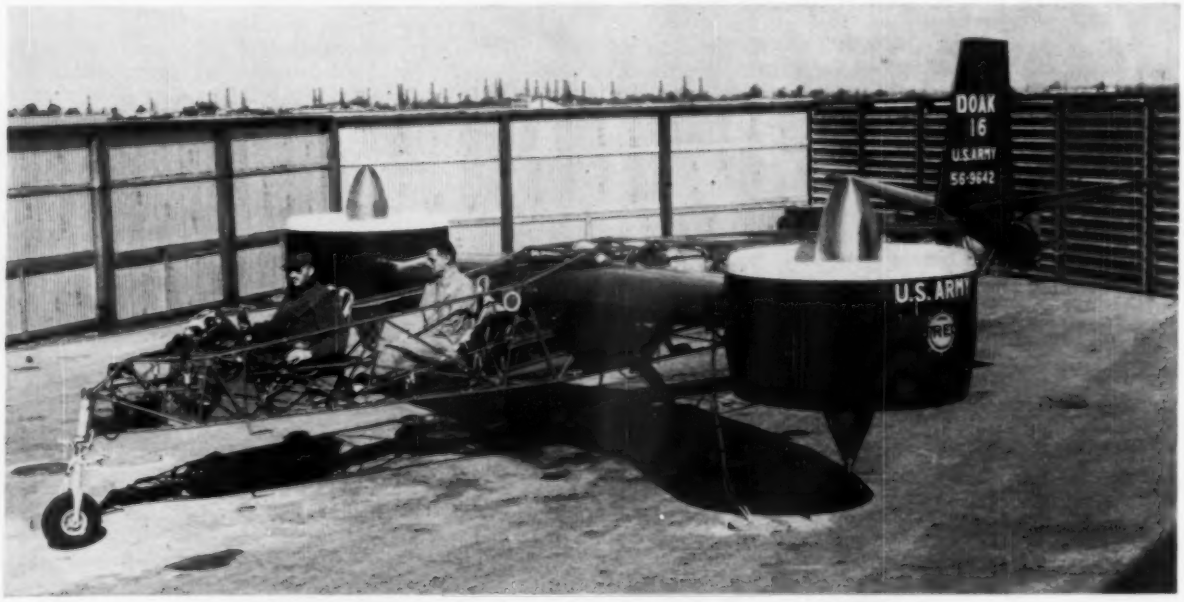
Detroit Applies Law

City of Detroit applied the law to Borg-Warner which had leased a government-owned plant in Detroit. The company was conducting no defense work at the facility.

The township of Muskegon, Mich., made use of the same law to tax a Continental Motors Corp. plant where several government supply contracts were being filled.

Both Borg-Warner and Continental Motors contended in their test cases that the tax violated the immunity of federal property from state taxation. The court denied their petitions by a seven-two vote.

In the case of taxing government-owned inventories, the majority ruled in a precedent-breaking decision that the tax was applied as a "levy on a private



First Photo of Doak X-16 Ducted VTOL

Structural details are visible on uncovered Doak X-16 VTOL, which recently made tethered flight. Wingtip-mounted ducted fans in position shown are used for vertical takeoff and landings, rotate 90 deg. for highspeed forward flight.

party possessing government property which it was using or processing in the course of its business." As such, it ruled, the tax is applied on all personal property throughout the state of Michigan, is not discriminatory against persons holding federal property and is not unconstitutional.

In rejecting the Borg-Warner and Continental Motors plea, the court ruled that the tax was imposed "on a party using tax-exempt property for its own beneficial use and advantage" and, therefore, legal.

Senate Group Votes NACA $10.5 Million

Washington—Senate Appropriations Committee last week voted $10.5 million additional funds for National Advisory Committee for Aeronautics for the remainder of the 1958 fiscal year—$1 million more than allowed by the House, but still below NACA's request for $11.3 million.

The Committee took these actions:

- **Eliminated a House proviso** which banned the use of additional expense funds for personnel salaries and added $220,000 to cover salary increases already granted. Under the House action, NACA would have to reduce personnel to have funds to meet the increases.
- **Agreed with the House** in refusing funds for 465 new positions. NACA asked for $950,000 additional to increase personnel from 7,935 to 8,400, as a step toward the 9,000 level provided in the fiscal 1959 budget.
- **Approved NACA's request** for $9.9 million for construction and equipment in full. The House allowed only $8.7 million, eliminating funds for office space. The money is for a new building to centralize data-processing facilities at the Langley Laboratory, Va.; an ultra-high-temperature materials facility, also at Langley, to simulate the aerodynamic conditions encountered during the atmospheric entry of a long-range ballistic missile, and for instrumentation of a McDonnell F-101 fighter to permit flight studies on various dynamic systems used in high performance aircraft and missiles.

The Senate Committee also voted additional funds for:

- **National Science Foundation,** $9.9 million, the full amount requested, to accelerate activities by supporting a greater number of basic research proposals that have been received, by expanding the translations of foreign-language literature in the basic sciences, and by expanding science education. House approved $8.7 million.
- **International Geophysical Year,** $2 million, the amount approved by the House, to provide for radio and optical tracking of Russian satellites.

J. V. Naish Named Convair President

San Diego, Calif.—J. V. Naish will succeed Gen. Joseph T. McNarney (USAF-Ret.) as president of Convair Division of General Dynamics Corp. on April 1. Elevation of Naish, former executive vice president of Convair, was predicted by Aviation Week on Dec. 9 (page 23).

Gen. McNarney, 64, who retires both as Convair president and senior vice president of General Dynamics, will continue to serve as a consultant and as a member of the board of directors. He had served as Convair president since 1952.

J. V. NAISH

Naish, also named a senior vice president of General Dynamics, joined Consolidated Vultee Aircraft Corp. in 1949 in the dual post of corporate director of contracts and San Diego Division manager of contracts.

In 1952, he became executive vice president and retained the position when Convair was merged into General Dynamics on April 30, 1954.

Bright Future Cited For Manned Aircraft

Washington—Air Force Secretary James H. Douglas says approximately 50% of USAF procurement funds will be spent on manned aircraft "for some years to come."

Douglas' appraisal of the future need for manned aircraft was reinforced at the Jet Age Conference of the Air Force Assn. here by Air Force Chief Scientist Dr. George E. Valley, Jr., and Maj. Gen. James Ferguson, USAF director of requirements, deputy chief of staff, development.

Gen. Ferguson told the conference that, "With all of their capability, the destructive power of the missile is not equal to that of the manned bomber. This power is measured both in terms of accuracy and weapon carrying capability. Ideally, missiles would seem most suitable against large industrial complexes.

"This alone, however, is not sufficient to defeat an enemy nor is it in accordance with Air Force doctrine. A balance of missiles and aircraft of varying performances is needed to produce the greatest threat to an aggressor and the one most difficult to defend against."

Gen. Ferguson said Air Force programs include "manned systems of unlimited range operating on nuclear power at low or high level. Combinations of these characteristics could make them relatively invulnerable to detection, and they would be able to stay 'on station' throughout the world, ready for instant attack."

Manned interceptors for defense also will continue to be "essential," Gen. Ferguson said, in order to identify and destroy attacking vehicles "as far from his target as possible."

The North American F-108, he said, will be equipped with long-range search radar, automatic inertial navigation and far-reaching guided atomic missiles and have "the tactical mobility essential to fight tomorrow's air battle."

Dr. Valley warned that "because missiles are new and remarkable feats of technology" too many people feel "that they must automatically be superior weapons and will, therefore, inevitably be adapted."

He added: "This is too simple a view; missiles are indeed new weapons, but they are additions to our armament; their properties are complementary to those of the manned airplane.

". . . I feel it a great mistake to infer, or to state or even to imply that there is some kind of competition between unmanned aircraft or missiles and manned aircraft. Missiles in the beginning will augment our manned force; they will not replace it until they are thoroughly tested, and we are sure of their reliability."

In summation, Dr. Valley said he had "tried to show that the strategy of missile warfare is not predictable because we cannot guarantee the assumptions; and that, therefore, we should not place reliance upon missiles alone."

F8U Rocket Funds Cut

Government has withdrawn funds from program underway at Reaction Motors, Inc., to develop rocket engine for Chance Vought F8U Crusader. The government is still interested in subject of inflight thrust augmentation for the jet-powered fighter, but the question now is to what degree the government will back this interest with money.

Thor, Jupiter Use Vernier Engines For Precise Trajectory Control

By Michael Yaffee

New York—Air Force disclosed last week that both the Thor and Jupiter will employ vernier engines—in two different ways—to obtain precise trajectory control.

Thor has two vernier engines. They are 180 deg. apart, one on each side of the sustainer nozzle. The vernier engines are started before the sustainer and continue to function after the sustainer is cut off. They can be swiveled, as required, to twist or roll the missile into the prescribed trajectory. They have their own propellant.

Unlike the Thor, the Jupiter has no vernier engines in its base. Instead, it is mounted on a rotatable launch pad which swings the missile to the programmed azimuth before firing. Once the Jupiter is fired, a single turbo-exhaust nozzle near the base of the missile, which can be swiveled as required, provides limited roll control.

Approximately 90 sec. after the Jupiter rises off its launch pad, the nose cone separates. At this point, the sustainer has brought the vehicle roughly to the speed required for the prescribed ballistic trajectory. A single vernier engine in the base of the nose cone then adjusts the velocity of the cone to within one foot/second of the exact speed. The vernier engine is fueled from its own solid propellant supply and can fire up to 45 sec. Once the nose cone is at the proper speed, the bottom section—containing the vernier engine and the guidance—is separated and the warhead continues to target.

Additional details on the operation of both missiles were given by Col. William C. Erlenbusch and Col. Harry J. Zink. Both officers are with the USAF Strategic Air Command. Col. Erlenbusch will command the first Jupiter IRBM squadron now being trained at Huntsville, Ala., and Col. Zink is in charge of the first Thor IRBM squadron, in training at Camp Cook, Calif.

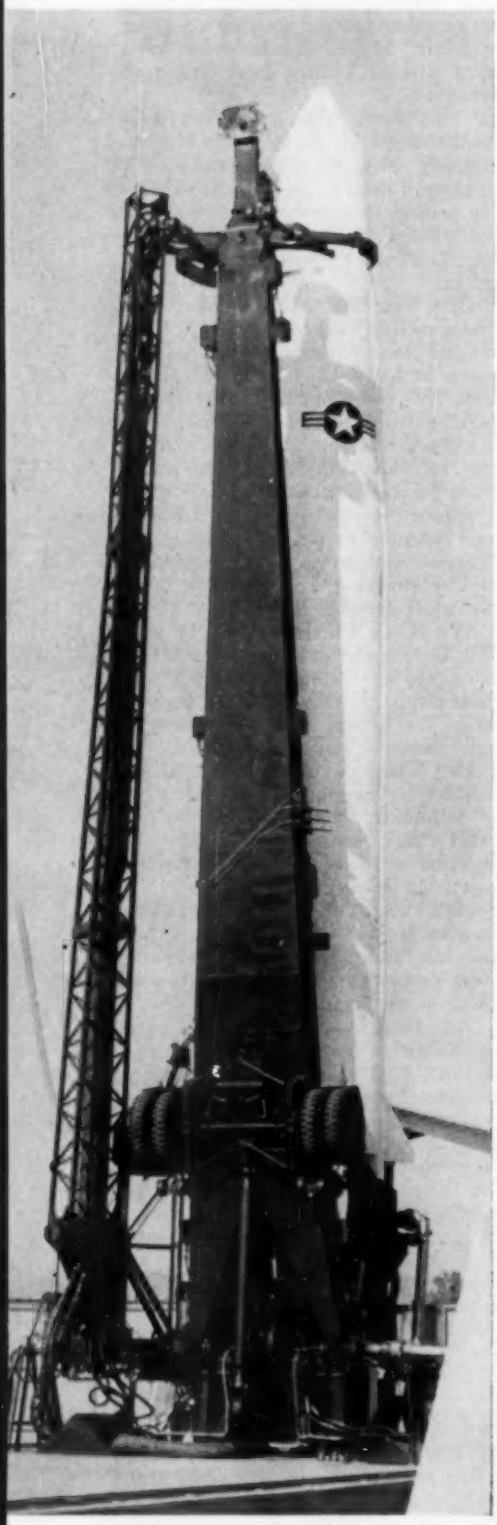
• **Each squadron** will have 15 missiles. In operation, the Jupiter squadron will have six missiles vertically positioned on launchers, in a ready state of T-15 minutes, and capable of being fired simultaneously. Six more Jupiters will be nearby and ready for erection as soon as the first six are fired. The remaining three missiles will be in the maintenance shop or someplace else where they are not readily available.

• **All 15 Thors** will be ready at the T-15 minutes countdown and capable of being fired simultaneously. Unlike the Jupiters, they will be in a horizontal position on their transporter-erectors inside long closed hangars. On an alert, the shed will be rolled away, the missile will be hydraulically raised on its transporter to a vertical position, the transporter will be lowered, and the missile will be left upright alongside a single servicing pole.

• **Propellant loading** of the Thor will begin as the missile is being erected. Under pressure of gaseous nitrogen, fuel will be fed from a storage tank into the top of the missile, and the oxidizer will be fed, under pressure of gaseous oxygen, from another storage tank into the bottom of the missile. Meanwhile all checkouts will be made and, after the propellant tanks are loaded, they will be topped off. At T-2 minutes, the topping and checkouts are stopped. The vernier engines are started and, at zero minutes, the sustainer is fired.

• **Jupiter operation** is less automated than that of the Thor, and requires about 8% more people (there will be 500 to 600 persons in the Thor squadron). The time difference is negligible, says Col. Erlenbusch. The Jupiters are erected by using cables and winches. (To be ready in a T-15 condition, they must be upright on their firing pads, and so have no hangars). The propellants are pump-fed from trucks instead of storage tanks and hose connections are made by hand.

• **Thrust of the Rocketdyne engine** used in the Thor and Jupiter was given



THOR is hydraulically lifted to upright position on its transporter-erector seconds after an alert is sounded. The transporter-erector is lowered and the missile remains standing alongside servicing arm (left) which falls away on firing.

Project Minuteman

Washington—Air Force is developing a three-purpose, solid-propellant ballistic missile weapon system that can be used as a tactical weapon or fired over intermediate and intercontinental ranges.

Designated Minuteman, the weapon system is scheduled to become operational in 1962 and will be fired from underground launching sites. Third stage of Minuteman could be used as a tactical ballistic missile over 500-1,000 mi. ranges. Second and third stages could be combined to form a 1,500-mile intermediate range ballistic missile for deployment overseas. All three stages would be deployed as an intercontinental ballistic missile.

In receiving Defense Department approval to go ahead with the project, Air Force also was told to consider use of Navy's solid-propellant Polaris IRBM as an interim weapon and to accelerate development work on liquid propellants.

as 150,000 lb. by both Col. Zink and Col. Erlenbusch. The engine operates on liquid oxygen and RP-1. (RP-1 is a light cut kerosene, distilled off between 380F and 525F, and has few contaminating aromatics. JP-4, on the other hand, is a wide cut gasoline, taken off between 200F and 550F, and contains more of the lower energy aromatics).

With minor changes in valves and the like, the engine could use the new, higher energy, hydrazine-based fuel developed by Rocketdyne for the Redstone first stage of the Explorer. But it is doubtful that the performance gain would warrant it. It would be preferable to design a system around the new fuel, Col. Erlenbusch said.

On Feb. 28, the Air Force fired factory model 120 in the Thor series. Model 121 is at Patrick AFB and scheduled for firing shortly. The missile was the first to be fitted with the new General Electric Mark I nose cone, a radically flattened structure designed to carry the warhead safely through the critical re-entry period. The nose cone was successfully separated after the missile traveled about 1,100 mi.

Use of the nose cone, Col. Zink said, indicates that the Thor program has entered the final test phase. He expects to have his squadron in England in the near future, where the unit's main purpose will be to train the British to operate the Thor.

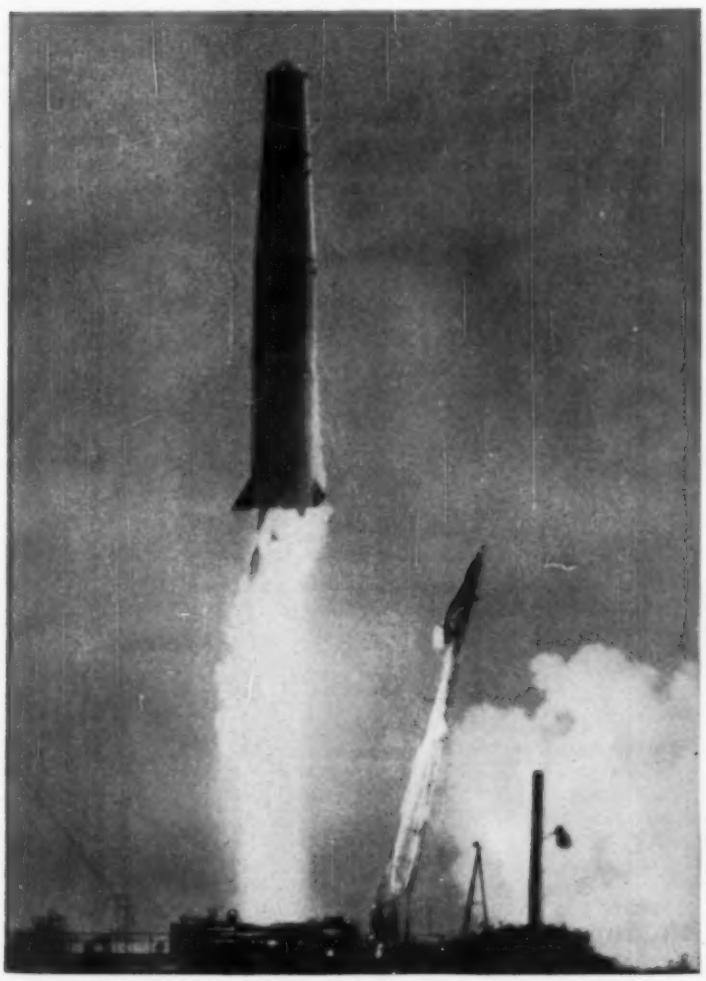
No decision has yet been reached on the disposition of the first Jupiter squadron. For that matter, continuation of the Jupiter program is still open to question. But Col. Erlenbusch is quite certain that Jupiter production will not be discontinued until at least one Jupiter squadron is in operation.

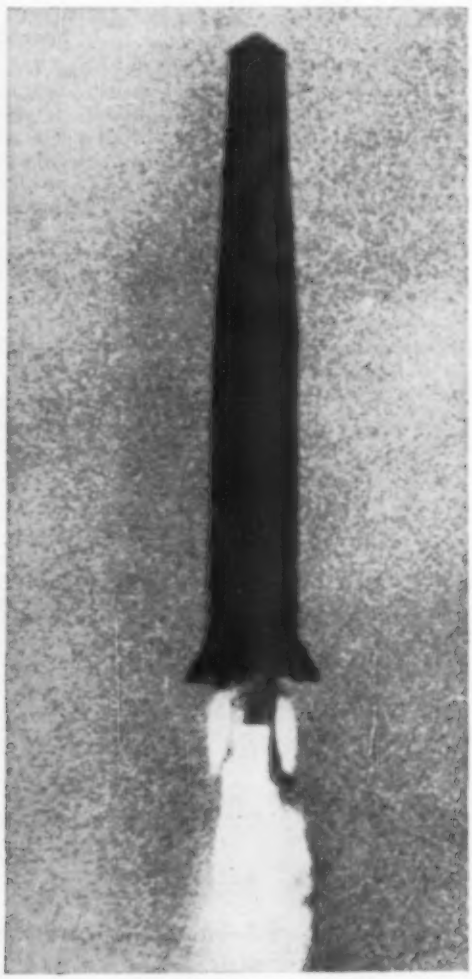
Navy Sets Polaris Flight Test

New York—First flight test of Navy's Polaris 1,500-mi. fleet ballistic missile will be made this fall from USAF's Missile Test Center, Cape Canaveral, Fla. Initial production of the missile will begin next year.

Dan A. Kimball, president of Aerojet-General Corp. which makes the solid propellant powerplant for Polaris, told a recent meeting of the Security Analysts here that a number of the engines already have been fired and that test firings are being accelerated.

Kimball also said Aerojet recently fired "the largest solid propellant engine which has ever been made, and we plan on firing an even larger one within the next 30 days." A similar claim also was made recently by Thiokol Chemical Corp., and one Defense Department official said last week that both statements could be true, "depending upon the day of the week it's made."





WITH VERNIER and sustainer engines firing, Thor takes off on first flight test of new nose cone. As missile rises (right), the three exhausts become well defined. Vernier engines continue to fire after sustainer stops.

Bill Demands Cut in Defense Secretaries

Washington—House Armed Services Committee will begin hearings early next month on legislation that would slash the number of Pentagon secretary posts from 29 to 15.

The measure reorganizing the Defense Department was proposed by Rep. Carl Vinson (D.-Ga.), chairman of the committee; Rep. Leslie Arends (R.-Ill.), ranking Republican, and Rep. Paul Kilday (D.-Tex.), chairman of the subcommittee on reorganization, after six weeks of testimony on the defense program.

Committee Proposals

The measure would:

- **Abolish four Assistant Secretary** of Defense posts—for Public Affairs, for International Security Affairs, for Health and Medical Affairs and General Counsel.
- **Merge the posts** of Assistant Secretary for Properties and Installations and Assistant Secretary for Supply and Logistics into an Assistant Secretary for Materiel Requirements. The three other assistant secretaries would be for Research and Engineering, for Manpower and Reserve and Comptroller as at present.
- **Abolish the Under Secretaries** and two of the present four Assistant Secretaries of Army, Navy, and Air Force.
- **Slash the number of civilian** employes in the office of Secretary of Defense from 2,400 to a maximum of 600. The sponsors estimated that this "will undoubtedly eliminate an unknown number of ad hoc committees."
- **Make the secretaries** of the three military services, as well as the Secretary of Defense, regular members of the top policy-making National Security Council.
- **Ban the comptroller from** supervising or controlling military programs.
- **Strengthen the authority** of the Joint Chiefs of Staff over unified commands.
- **Limit tours on the Joint Staff** to three years except in time of war. In a joint statement, Vinson, Arends and Kilday declared that this "will, first, prevent the creation of a self-perpetuating clique of special staff officers who would be increasingly isolated from combat reality, and, second, it will provide for an in-flow of current and realistic military experience to the Joint Chiefs of Staff and an out-flow to the operational commands of officers experienced in military planning at the national level."

Sponsors' Aims

The three sponsors said the bill "will improve our national security by changes that will provide a defense system that exposes rather than obscures facts, that reveals rather than conceals problems, and facilitates rather than impedes decisions."

Meanwhile, the committee divided into six subcommittees to make a detailed study of Defense Department—from business practices to military missions. These are:

- **Military strength.** Headed by Rep. Overton Brooks (D.-La.), the group will weigh the adequacy of the military posture of the three services and reserve components to meet assigned missions and comply with treaty obligations; evaluate the soundness of the stable force concept for the foreseeable future; analyze the present combatant capabilities of the services to wage nuclear, conventional, limited, or total war.
- **Organization.** In addition to reorganization, this group headed by Rep. Kilday will consider the roles and missions of the three services. Because of the difficulty in predicting the effect of new weapons on strategy, Kilday favors giving the Secretary of Defense substantial discretion in the assignment of service roles.
- **Outer space.** A key issue to be considered by this group, which is headed by Rep. Carl Durham (D.-N. C.), is whether military outer space programs should continue to be handled by Advanced Research Projects Agency. Legislation enacted Feb. 12 authorizes ARPA to engage in space projects for one year. The subcommittee will also consider the status and progress of missile, anti-missile and satellite programs.
- **Bases.** This group headed by Rep. Mendel Rivers (D.-S. C.) opened executive sessions last week on the adequacy of Military Air Transport Service's system of bases.
- **Budget.** The policy of impounding defense funds appropriated by Congress is the main subject this group, headed

FJ-4F Equipped With Supplemental Rocket Engine

North American FJ-4F fighter has been modified to accommodate AR-1 rocket engine, designed and developed by Rocketdyne Division of North American Aviation, Inc. AR-1 is positioned over 7,800 lb. thrust Wright J65-W-4 turbojet tailpipe. Fighter's nose carries added instrumentation for testing at Naval Air Test Center, Patuxent River, Md. Rocket is using hydrogen peroxide and JP-4 in tests.

First Picture of Piasecki VTOL

Detailed full-scale mockup of Piasecki Aircraft Corp.'s new model 59K VTOL for Army shows placement of two armed infantrymen and soldier-operator between horizontally mounted three-blade rotors in ducts fore and aft. Low, flat silhouette is designed to permit Piasecki 59K to hug the ground, fly under bridges and wires. Protecting propellers in ducts would permit craft to thread its way past obstacles safely. Fore and aft are inflated rubberized fabric bumpers. Three-wheel landing gear provides ground mobility. Piasecki has a full-scale test rig of the 59K mounted inverted on a trailer truck which is operated at Philadelphia International Airport to provide simulated flight test data. Strain gages on test rig record data on electronic printer in a cab on the truck. Novel test rig has been operating at the airport for approximately one month, providing considerable information on control systems prior to actual flight tests of prototype, scheduled for next month. Prototype will be powered by two Lycoming flat piston engines. Speeds of 150 mph. are envisaged for 59K by President Frank N. Piasecki. Vehicle is expected to fly over most mountain ranges in U. S.

by Rep. Philip J. Philbin (D.-Mass.), will consider.

• **Procurement.** The subcommittee will limit its review of procurement policies to missile contracts and expects to take testimony from missile contractors as well as service representatives. In addition, this subcommittee, headed by Rep. Edward Hebert (D.-La.), will review classification and dissemination policies, particularly on missiles. Closed hearings are scheduled to start March 10.

Vinson and Arends are ex-officio members of each subcommittee. All hearings will be held in executive sessions.

Boeing, United Report Billion Dollar Sales

New York—Two more aviation companies joined the billion dollar 1957 sales list last week—Boeing Airplane Co. and United Aircraft Corp. United Aircraft topped the billion mark for the first time, but it was the second year in a row for Boeing.

Boeing's sales total—$1,596,508,515—was a peacetime record for an aviation company although Curtiss-Wright Corp. in 1944 reported a total of $1,716,935,177.

United Aircraft's net income for 1957 was a record for aviation companies.

Its consolidated net earnings of $51,366,108 topped a previous record of $43 million run up by Curtiss-Wright in 1956 and topped the company's own 1956 earnings of $37,082,493.

These are the third and fourth aviation companies to top the billion dollar sales mark for 1957.

Douglas Aircraft Co. reported $1,091,366,000, its second consecutive billion dollar year. Another company North American Aviation, Inc., reported $1,243,767,483.

General Dynamics, which includes Convair as well as several non-aviation divisions, reported sales of $1,047,818,510 for 1956 and forecasts a total of around $1½ billion for 1957.

Douglas earnings of $30 million represented a decline, blamed by the company on heavy development costs of the DC-8 jet transport. Boeing's earnings were higher as were United Aircraft's.

Boeing said that its earnings of $38,159,707, compared with $32,134,989 on sales of $1,006,356,748 in 1956, amounted to a reduction of earnings per dollar of sales.

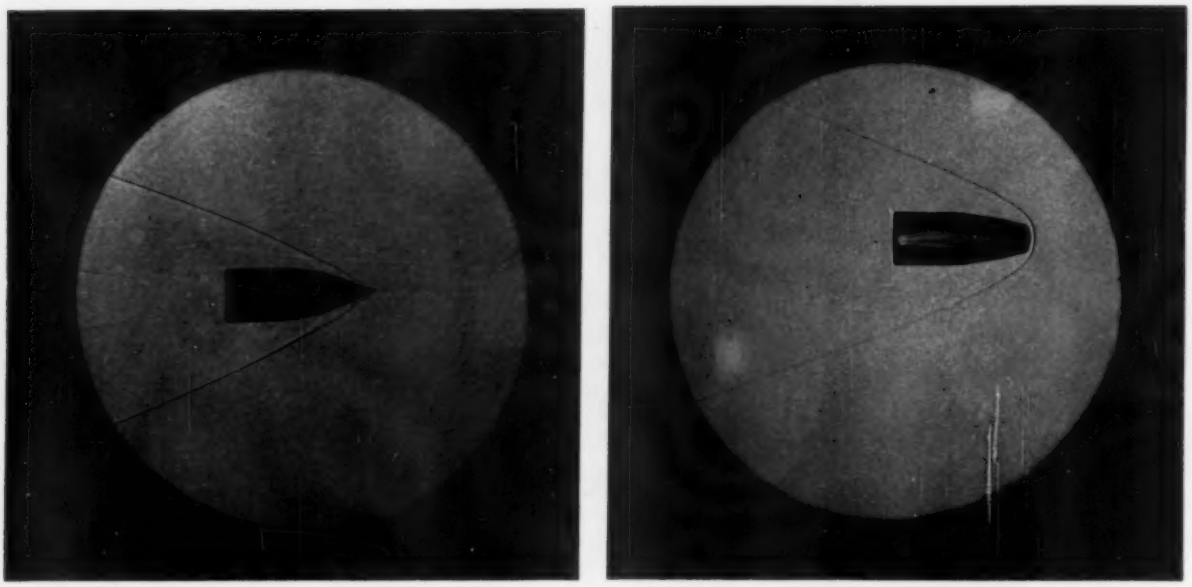
After taxes, earnings in 1957 amounted to 2.39 cents per sales dollar compared to 3.19 cents the year before, Boeing said.

The reasons cited reflect the current economic climate to some extent and go back to the government's fiscal troubles and cutback last summer: reduced gross profit margins on incentive-type fixed price contracts, increased interest charges, increased amortization charges on new facilities and the write-off of $17 million for development and general expenses of commercial programs.

United Aircraft record sales of $1,232,919,313 were a 29% increase over the 1956 total of $952,885,142. Net income in 1956 was $37,082,493, or $5.87 a common share compared with $7.96 a common share in 1957.

As in the case of Douglas, (AW March 3, p. 332), United Aircraft reported a drop in backlog, from $2,300,000,000 to $1,975,000,000. Boeing reported a backlog of $2,452,000,000 with $792,000,000 applicable to commercial sales.

Impact of missiles is being noted in most aviation annual reports, but United Aircraft commented: "It is still our best judgment, however, as stated in our 1956 report, that the missile will not displace the manned aircraft in the foreseeable future, and most probably will never do so."



SHADOWGRAPH (left) clearly "stops" .22 bullet traveling 4,100 fps. Exposure of .01 microsecond was taken with synchronized spark light source of 0.12 in. dia. and 2-in. Kerr cell. Right, same setup but with synchronized front lighting "stops" .22 bullet traveling 4,100 fps.

Shutter Improves Shock Wave Photos

Wind tunnel and ballistic range photographs capable of freezing shock waves and ballistic projectiles at speeds to 0.01 microseconds have been obtained with a Kerr cell electro-optical shutter and pulse generator designed by Avco Manufacturing Corp.

Kerr cell shutter passes light only when an applied electromagnetic field rotates polarization of incident light so that it passes through a polarized filter.

Because the shutter is triggered by an electrical pulse, it can operate up to 10 times faster than conventional systems such as the Schlieren camera which depends upon duration of a flash of light.

Shutter has been developed by the company's Research and Advanced Development Division for aerodynamic studies of long range missile re-entry problems where exposure times of 10-7 to 10-8 are required to prevent image blur of scaled-down high velocity projectiles.

Avco holds contract for development of the Titan ICBM missile re-entry nose cone.

Two principal advantages of the electro-optical technique are:

• **High speed.** Rise and decay time of light flash used to obtain high speed photographs in most present systems limits speed to about 0.1 microseconds. Kerr cell shutter is faster because rise and decay time of required electrical pulse is about 10 times faster.

• **Front lighting.** While Schlieren or shadowgraph techniques sacrifice illumination of the model or projectile to obtain shock wave definition, the Kerr cell shutter can be used in combination to provide front lighting of the subject and back lighting to define shock waves.

Applications of the technique include ballistic projectile photography, shock wave transition studies in wind tunnels, high explosion analysis, spark gap and exploding wire studies, and model studies in high intensity arcs where high speed exposures hold back the self-luminosity of models exposed to hot plasma.

SEALED square Kerr cell produced by Avco has permitted exposure times to .01 microseconds.

Electro-optical shutter consists of three elements:

• **Polarizer.** Light incident upon the shutter is polarized by a filter in front of the Kerr cell. Characteristics of the filter limit angle of incident light to about 10 deg., providing a limiting aperture of about f/2.5. Overall insertion loss of the shutter adds about four stops, bringing effective aperture to f/10.

• **Analyzer.** Behind the Kerr cell is a second polarizing filter offset 90 deg. from the first. With no current applied to the cell—the "off" condition—light polarized by the first filter will not pass through the second. The two filters are not completely opaque but do provide a transmission ratio of about 20,000 to 1 with conventional, unselected polarizing material.

• **Kerr cell.** Between the two filters a nitrobenzene-filled cell provides 90 deg. phase rotation of the electromagnetic light vector when a current pulse is applied. Electric field required to produce the rotation lies between 10 to 15 kilovolts per centimeter; 5 cm. aperture requires 50 to 75 kilovolts applied to the Kerr cell plates.

Dimensions of the complete shutter, including the pulse generator and a specially designed spark gap which provides the driving signal, are 12 x 12 x 5 in. Shutter requires an external 0-50 kilovolt power supply and a low voltage trigger source.

French May Receive F-100Cs From U.S.

Paris—United States is quietly preparing to turn over to the French Air Force several squadrons of North American F-100C Super Sabre fighters to help shore up France's sagging NATO air contribution.

The F-100C fiighters will be supplied to France as off-the-shelf hardware under U.S. military aid program. Move marks the first time the U.S. has supplied any NATO ally with supersonic F-100s. North American fighter is the latest type equipment being used by USAF units in Europe.

Franco-American deal is being described in Paris as secret by both the United States and French military officials. However, AVIATION WEEK has learned that at least two squadrons of F-100Cs representing about 50 aircraft are involved in the initial batch being turned over to the French. Aircraft will be used to replace the obsolescent Dassault Mystere fighters as well as to supplement the French supersonic Super Mystere just now coming off the production line.

Main reason for official silence surrounding the F-100 agreement is current complaints in the United States over the use of the French Air Force of U.S.-supplied aircraft in the North African rebellion. Observers with longer memories also have cited French Air Force use of U.S.-supplied Republic F-84s in the Suez campaign. With feeling against such practice running high in the United States, American and French officials understandably want to keep the new agreement quiet for the time being.

Further reason for keeping the agreement under wraps is that it comes at a time when the French Air Force, because of its air role in the Algerian war, is rapidly losing its capability to sustain any significant NATO air effort in Europe. Evidence now cropping up in responsible Paris quarters reveals that the manpower drain of the Algerian war has resulted in serious curtailment of French Air Force jet pilot training and operational flights and even abandonment of several radar stations in Europe.

Much of this evidence was supplied on the floor of the National Assembly during recent debate on the air force budget. Budget has been fixed at 325 billion francs, which represents a reduction of about 25% from the 1957 budget. More important, French Air Force manpower strength is being pared to 125,000 men during 1958 from the 1957 figure of 165,000. French Air Force officials have stated that the minimum manpower level needed in order to carry out both NATO and Algerian air duties would be at least 136,000 men.

Manpower situation is even more complicated by a recent shift of an additional 10,000 air force personnel into infantry ranks in Algeria. Most of these men had been in the air force at least a year and were semiskilled technicians working on French Air Force jet bases and radar stations in France and Germany.

The budget figures on such an item as aviation fuel have been so low that Louis Christiaens, French Air Minister, warned deputies that unless the figure was revised upward, the French Air Force will be grounded before the end of the year.

Crash Kills First F-104 Unit Commander

Commander of the first operation Lockheed F-104 squadron, Lt. Col. Ray Evans, was killed last week during a GCA approach at Hamilton AFB, Calif., where his unit, the 83rd Fighter-Interceptor squadron, Air Defense Command, is based.

The aircraft was at an altitude of 500-800 ft. when it abruptly disappeared from the radar observer's scope. The wreckage was found in three sections in 9 ft. deep water in San Francisco Bay. The General Electric J79 engine was torn free and was found with the aft fuselage section.

Wreckage was taken to the Alameda Naval Air Station for investigation. Col. Evans had checked out in the F-104 before the aircraft went into operational service last month, and had considerable jet time and test pilot experience.

U.S. Chemical Milling Acquires Missile-Air

United States Chemical Milling Corp., Manhattan Beach, Calif.—metal fabricating and weight-removing subcontractor for the aircraft and missile industry—has acquired Missile-Air, Los Angeles airborne components manufacturer. Move is part of an expansion program.

Purchase, made for an undisclosed cash consideration, is intended to broaden U.S. Chemical Milling's subcontractual capabilities in spinning, shearing and forming and metal fabricating techniques. Missile-Air, in addition to manufacturing airborne and spaceborne equipment, produces missile and aircraft fuel tanks, ground handling equipment, control apparatus and sub-assemblies.

Acquisition of Missile-Air will expand U.S. Chemical Milling to over 200,000 sq. ft. of workspace.

News Digest

Reaction Motors, Inc. is stepping up development work on the rocket engine for the North American X-15. The engine, recently designated Pioneer, is now undergoing development testing at company's facilities in Denville, N.J.

Lockheed's second Jetstar prototype will be rolled out this month. Firm disclosed that the first Jetstar, now undergoing Air Force testing, exceeded speeds of 630 mph. and cruised at 45,000 ft. during company tests. Both aircraft are powered by two prototype Curtiss-Wright TJ37 jet engines (Bristol Orpheus series).

Rolls-Royce Tyne turboprop engines will power RCAF's Canadair CL-44 transports, replacing originally planned Bristol Orions. Withdrawal of British government support of Orion development forced the move, which will give Rolls-Royce estimated $2 million contract.

Kaman Aircraft employes received a two cents per hour cost-of-living pay increase last week as the January Consumer's Price Index showed a 1.2 rise. Firm's cost-of-living increases during 1957, which were added to base pay rates at the year's end, totaled seven cents per hour.

Hercules Powder Co. has created a chemical propulsion division within its explosives department. The division will design, develop and produce solid propellant rocket engines.

New Talos Version

Washington—Follow-on version of the Navy's Bendix Talos ramjet surface-to-air missile will have a range of approximately 80 mi. and is scheduled to become operational in about one year.

Capt. Leslie Slack, of Navy's Bureau of Ordnance, told the House Appropriations Committee in Fiscal 1959 budget hearings that more than a half a dozen of the follow-on versions have been test fired.

Capt. Slack did not give the range of the follow-on missile but said it would double that of the present Talos which has a range of more than 40 mi.

The Bureau of Ordnance official said that, although the Talos is primarily a surface-to-air missile, the Navy has the capability of using it against another surface target at sea, or also on land. He added that the missile is also being evaluated for possible anti-ballistic-missile missile capabilities.

Tension Rises in Pilot-Engineer Dispute

Fact finding board's decision would set precedent for jet-age negotiations between carriers, crews.

New York—Dispute between airline pilots and flight engineers, a serious threat to jet-age negotiations between carriers and their crews, continued to build up steam last week in the wake of these developments:

- **Presidential fact finding** board emergency hearings in Flight Engineers' International Assn.-Eastern Air Lines struggle reopened in Miami after moving from New York.
- **Western Air Lines,** its pilots out on strike on other issues, sought settlement of the jurisdictional question now to avoid trouble when the airline begins operating turboprops.
- **Third-man-in-cockpit** theme brought discord into contract discussions between several airlines, the Engineers' union and/or Air Line Pilots Assn.
- **Special subcommittee** of AFL-CIO found it "imperative" that the two associations merge to handle the flight duties of new turbine aircraft. The pilots expressed willingness to merge but the engineers balked.

Board's Task

The fact finding board in the Eastern case, which also will hear an ALPA-Eastern dispute over new contract terms, has an important and difficult task in deciding whether the airline should specify contractually whether the third man in turbine cockpits shall be mechanic-qualified or pilot-qualified. The board's decision is certain to have an industry-wide effect on other negotiations involving the jurisdictional issue. The flight engineers insist that Eastern specify mechanic engineers, and ALPA demands that Eastern specify pilot engineers.

AFL-CIO President George Meany on Feb. 3 appointed a subcommittee to consider charges filed last December by the flight engineers, who claimed that ALPA cooperated with employers by encouraging ALPA members to obtain flight engineer licenses in order to weaken the engineers' bargaining position; and that ALPA was informing its membership that ALPA's program had support of AFL-CIO leaders.

The subcommittee's answer to FEIA's charges against ALPA:

"The committee recommends that the airline pilots be instructed to recognize the jurisdiction of the flight engineers and refrain from attempting to enlist flight engineers into membership in the ALPA.

"The subcommittee in going over the record finds that this question between these two organizations has come up before.

"The committee feels that the executive council can never resolve the problems of these two organizations until the two organizations themselves sit down and honestly try to find a solution which will be amicable to both sides."

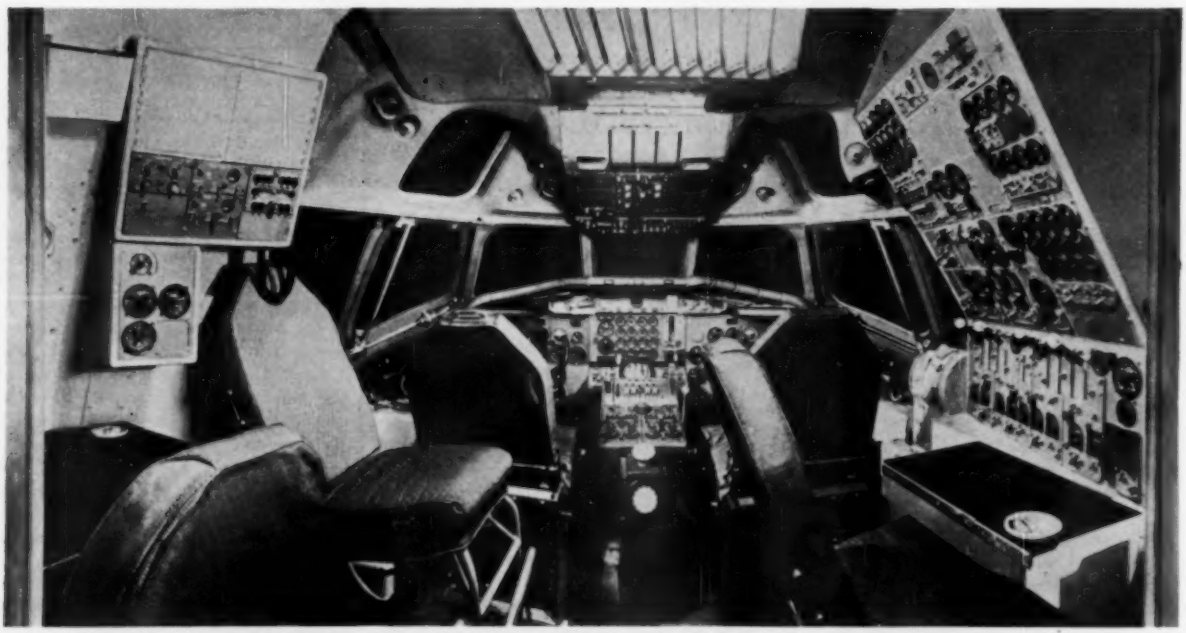
'One Organization'

In another section of the subcommittee report, dealing with flight crew complements, the three AFL-CIO vice presidents found that "the close relationship of the flight crew which is now faced with the introduction of an entirely new series of larger and faster aircraft powered with turbine engines, makes it imperative that the flight crew belong to only one organization. . ."

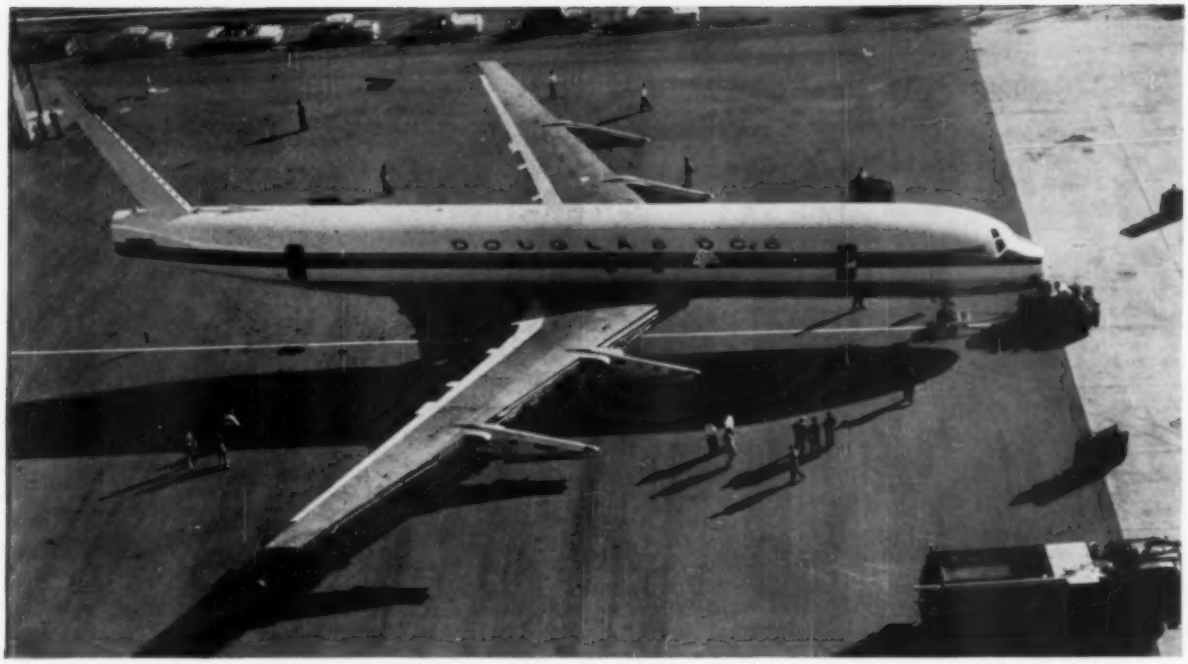
The subcommittee recognizes, its members reported, that the captain or pilot in command of an airliner has full responsibility for its safe operation.

The responsibility placed directly on the pilot by virtue of his license cannot be delegated to his employer or anyone else, the subcommittee noted, and this also makes it necessary that flight crews be coordinated into one organization.

"There is no trade union reason why



DC-8 COCKPIT mockup shot with flight engineer's station at right was union exhibit at emergency hearing.



ROLLOUT of nearly complete Douglas DC-8, third of U.S.-built turbine transports, underscores importance of ALPA-FEIA jurisdictional struggle. DC-8, minus engines, leading and trailing edges, tail, was moved out for repositioning in final assembly building.

the merger of these two organizations cannot become a reality," the report said. It also pointed out that Meany had advised ALPA in March, 1957, that AFL-CIO would assist in bringing about an amicable solution to the dispute. This offer should be accepted, the subcommittee added, because of technological changes in the field of aircraft problems.

ALPA President C. N. Sayen has advised Meany that the pilots are prepared "to begin merger discussions immediately." FEIA President George R. Petty, Jr., announced later that he was "bound by a resolution of our executive committee not to discuss merger with any other union. We are an international union with a recognized charter and no unilateral decision can force us to merge." The Petty statement followed a comment in Chicago by ALPA First Vice President G. M. Lerroux that Petty had not been heard from after Sayen had announced his willingness to talk merger. The third crew member was established by government regulation in 1948, the AFL-CIO report noted, with the advent of larger, faster, more complex aircraft. Some airlines assigned mechanics, some assigned pilots, and some assigned both to the new category. The third crew member is now variously represented by FEIA (about 90% of the total), ALPA and in one case by International Assn. of Machinists.

ALPA's policy for crew complement on turbine-powered aircraft was set by the association's directors at a meeting in November, 1956. Struggle between the two unions began previously.

FEIA last year presented Trans World Airlines with a detailed paper spelling out the duties of flight engineers on turbine aircraft, as FEIA sees them (AW Nov. 18, p. 43). The flight engineers argue that their duties will be greater in jets and the pilots' duties less. ALPA takes opposite view.

Among points at issue:

• **Fuel management**—Engineers: They will be required to keep half-hourly fuel logs and center of gravity computations. Fuel management is more critical and more exacting in jet operation, and this job is one of the flight engineer's present responsibilities. Pilots: Fuel management on a jet is simplicity itself; fuel is metered automatically in flight; "Surely, we can tell whether we have the right or left boost pump on to avoid . . . unbalance . . ."

• **Electrical systems**—Engineers: System in the 707 has 1.7 times as many cockpit instrument displays and controls as the average present transport; emergency procedures involving electri-

Comet IV Gets Idlewild Landing Rights

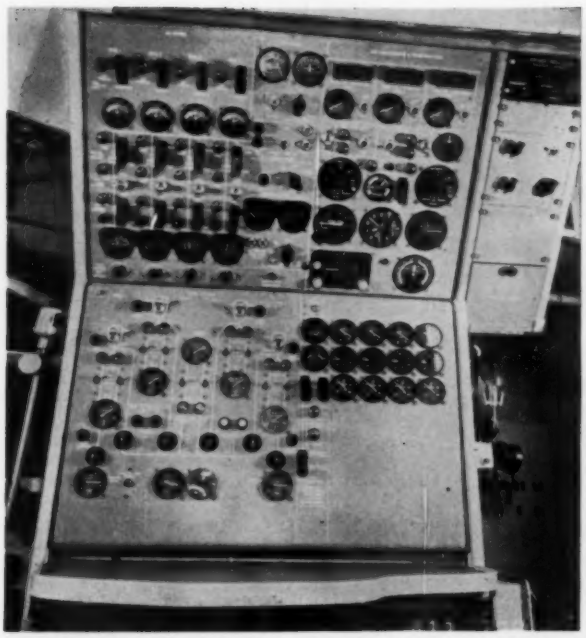
New York—Port of New York Authority cleared the de Havilland Comet IV for limited operation at New York International Airport. The airport, as well as Newark, LaGuardia and Teterboro, has been off limits to most turbojets by a long-standing Port Authority ruling based on noise considerations.

An earlier model of the Comet operated by Royal Canadian Air Force was denied the use of Idlewild. Port Authority permission for Comet IV flights specifies that the four-jet transport be equipped with Rolls-Royce noise suppressors for its RA.29 Avon engines. Daylight-only demonstration flights will be allowed under VFR conditions, and will be subject to preferential runway assignment under National Air Transport Coordinating Committee anti-noise procedure for the New York area.

The Port Authority said its acoustical consultants measured Comet IV noise at Hatfield, England, and found the plane quieter than present DC-7s and Super Constellations. Comet's suppressors reduce the overall noise of the aircraft by about four to six decibels, the Port Authority said.

Low-frequency takeoff noise of the piston transports was about 10 decibels higher than the Comet's noise, while high-frequency takeoff noise was about five decibels higher for the Comet.

Turboprop transports previously cleared by the Port Authority include the Vickers Viscount, Bristol Britannia and Boeing YC-97J. The twin-jet, unsuppressed Sud Aviation Caravelle also has been found acceptable by the agency.



CONVAIR 880 flight engineer's station (right) and Boeing 707 engineer position were pictured in exhibits.

cal failures will require extensive knowledge by the engineer of the location of components and their functions. Pilots: Although electrical demands have increased substantially, so have generating capacities. Systems are more versatile, are more completely self-monitoring, and failure is less critical than in some present systems.

• **Air conditioning and pressurization**—Engineers: Monitoring of systems by a mechanically skilled engineer can warn of impending failures or leaks and have them repaired on the ground before they reach the danger point; comprehensive instrumentation is being installed to prevent turbo-compressor overheat or overspeed accidents. Pilots: The pressurization system is automatic; if a compressor lets go, what could a flight engineer do about it that a pilot couldn't?

• **Powerplant icing**—Engineers: Turbine engines are very sensitive to severe icing conditions and are not basically adapted to handling much ice; turbojet engine instruments must be monitored to control this, and a trained specialist is needed to do this job scientifically. Pilots: The instruments for detecting ice are on the pilot's center panel and the engine bleed air anti-icing switch is on his overhead panel.

Western Issue

Western's pilots went on strike Feb. 21 on working conditions and pay issues. The third man question is a point of dispute in contract negotiations, but is not, according to the National Mediation Board, a strike issue.

ALPA wants the crew issue to remain open until some time between the end of this year and 90 days before Western's Lockheed Electra turboprops are put into service. Then the pilots would like to reopen negotiations on the point.

Western anticipates a jurisdictional dispute between the ALPA and FEIA when the Electras arrive and wants to settle the issue now. The airline conceivably could be in an uncomfortable position with a fleet of new airplanes and unsettled crew problems. Western asked the mediation board to set up a fact finding board similar to that hearing the disputes with Eastern. The board, however, refused to ask President Eisenhower to set up the emergency unit, holding that the issues are not comparable and that ALPA and Western should resolve their differences under the Railway Labor Act.

FEIA President Petty wired the National Mediation Board on Feb. 25 that his union would insist on an emergency fact finding board if the Western pilots demanded contractual control of the engineers as a condition of returning to work.

Mediation Board Secretary E. C. Thompson replied to Petty that "National Mediation Board has no knowledge of any demand of Western Air Line pilots as a condition of their return to work that they be given contractual control over the bargaining rights and qualifications of flight engineers on Western Air Lines."

The two cases differ in at least one respect: Eastern's contracts with both unions are expired and new ones must be signed, whereas Western last year signed a contract with FEIA.

Western's new route to Mexico City is causing part of the trouble with its pilots. A key issue is premium pay for the foreign flights plus coverage of such hazards as internment by a foreign government, off duty injury on Mexican soil. The pilots say they are asking that their working conditions simply be brought up to the standard of other airlines. American Airlines, according to the pilots, does not provide extra pay for its Mexico run but does cover the other aspects of foreign duty.

Western's management holds that ALPA's demands would cost the airline $6.5 million annually, a 195% increase in expenses. If costs were the same as last year, the increase would eliminate any possibility of dividends or retained earnings, according to Western.

Regarding the Western strike, a pilot spokesman said "ALPA is settling down for a long haul on this one."

Viscount Agreement

ALPA and Continental Air Lines recently signed a new contract which includes a pay scale for Viscount 812 duty. Eight-year captains flying these turboprops will draw $1,845 monthly, while eight-year co-pilots will receive $1,113 a month. The Viscounts, because of their size, will not carry engineers so the jurisdictional issue was not involved.

In addition to Western and Eastern, the pilots are seeking new contracts with American and Northwest Airlines. Negotiations with American have been in mediation and ALPA said recently it was "seriously considering a withdrawal from service."

The pilots want two contracts with American, one covering piston planes

and one covering turbines. This apparently is a maneuver to skirt the third man issue for the time being. American, however, can be expected to hold out for a single contract.

Trans World Airlines and ALPA expect to begin contract talks this summer. TWA has been studying the third man issue and probably will decide for itself which type of qualification it will require.

The flight engineers' association, in addition to Eastern, is negotiating with TWA (in mediation), Continental (in mediation) and United Air Lines (recessed). Negotiations with American will open soon, and contract with Seaboard and Western will be reopened next month.

BOAC Seeks Routes Across Russia, China

London—British Overseas Airways Corp. has asked the Ministry of Transport and Civil Aviation to negotiate for BOAC routes across Russia and Communist China.

Negotiations must be at government level, BOAC says, and route plans already have been submitted to the British government.

A possible route, London-Moscow-Peking-Tokyo, would save about a day over the present London-Rangoon-Hongkong-Tokyo route.

Production 707 Logs 47 Flight Test Hours

Renton, Wash.—Boeing Airplane Co.'s first production 707 jet transport logged 47 hr., 9 min. during its first six weeks of flight testing. Initial flight was made Dec. 20.

The airplane cruised at speeds above 580 mph. and at altitudes above 30,000 ft. during the first phase of its flight testing, Boeing reports. Highest altitude reached was 39,000 ft.

Tests included a flight into a weather front over the Pacific to check the 707's anti-icing system. With Civil Aeronautics Administration personnel aboard, three inches of ice was allowed to collect on the plane while wing and tail anti-icing systems remained shut off. No adverse characteristics were noted during the test, according to Boeing.

Other tests of the production jetliner have included cross-wind landings and instrument landing system checkouts. As of last week the airplane had made a total of 28 flights.

Test pilot James R. Gannett says the airplane comes fully up to expectations, and that only minor adjustments have been necessary.

High Jet Engine Overhaul Costs Detailed by American Official

By L. L. Doty

Washington—Possibility that jet engine overhaul costs for transport aircraft may initially run as high as $70,000 per engine and overhaul time as low as 600 hr. has been cited by William Littlewood, vice president of equipment research for American Airlines.

Testifying at the Civil Aeronautics Board's General Passenger Fare Investigation, Littlewood said line maintenance costs of turbine engines may be slightly lower than piston engine costs but that overhaul costs will be substantially higher. He added that the "unknown element will be the cost of materials replacements which may be very high."

Other highlights of Littlewood's testimony:

- **Complexity of accessory** and control apparatus of turbine engines will increase overhaul costs.
- **Cost of jet fuels** will likely climb to a level comparable to present costs of gasoline.
- **Instrument layout** in cockpits of jet transports will be subjected to a number of changes. Littlewood said plans to revise dial presentation of information to pilots "are radical in this area."
- **Successors to jet transports** now on order are not likely to appear until 1970. Supersonic jet transports may appear about 1975 for very long-range, highly specialized service.
- **Markets for used four-engine** equipment, particularly the DC-6 and DC-7 series, will become leaner as the rate of development of new aircraft continues to increase.

Overhaul Costs

Littlewood said that Air Force costs of a Pratt & Whitney J57 turbojet engine overhaul are about $70,000 and added: "We hope to better that, but we may have to start at this point." He said overhaul time will probably begin at 600 hr. as against the some 2,000 hr. maximum now attained on piston engines. He held out some hope that a starting point of 1,000 hr. may prove feasible.

The American official pointed out that labor costs are generally high and parts costs are normally moderate in the overhaul of reciprocating engines but that the converse will be true in the overhaul of jet engines.

He said, "the one thing you can't tolerate in a jet engine with its high rotative speeds is internal failures and, in order to prevent these, there will certainly be a strong tendency to lean over backward in parts replacements, and the parts, of course, are quite expensive and numerous."

Asked if jet transports will be more efficient than piston engine aircraft, Littlewood said the two types are equally efficient per unit of product. He said unit cost per airplane will be roughly the same but that turbine aircraft will provide a better and faster service, which, he added, is the "reward" for being able to operate jets at the same cost.

"We would like to do it at a lower cost, but it is not possible," he said.

Littlewood forecast that there will be little if any obsolescence in the performance factor of jet transports although he pointed out that last month there were .02 and .04 increases in the Mach limitation on proposed aircraft.

He admitted that this was a marked improvement in performance and that there is still a slight potential increase from present maximum speeds of Mach .92 or .94 to Mach 1 but warned that the margin of safety is reduced as performance gets closer to Mach 1.

Slick Asks Suspension

Slick Airways, Inc., has asked the Civil Aeronautics Board for authorization to suspend its scheduled services until Jan. 1, 1959. Delos W. Rentzel, chairman of the board and president of the all-cargo carrier, told the Board that Slick had lost substantial sums of money over the past year and a half which it has not been able to recoup from other activities, such as charter work.

Although the application requested temporary suspension, an airline spokesman told Aviation Week that resumption of service probably would depend on revised freight rate structure. Otherwise, the spokesman said, Slick will sell or lease its fleet.

On its scheduled all-cargo routes, which include transcontinental services, Slick lost $3,114,000 in the year ending last June 30, the Board was told. Total system losses for the same period were $2,021,000. From June 30 to Feb. 1, total loss for all operations was $1,200,000, the carrier said.

Rentzel blamed the Board's policies for a good deal of the trouble, contending that CAB "has exercised little of its promotional responsibility in connection with the development of all-freight carriers as such."

He said that obsolescence of jet transports could result from improvements in economy of operation. In the area of manufacture and materials, he quoted one manufacturing official as saying that the rate of obsolescence is five times higher than the rate during World War II because of work being done in research and development.

On this point, he said that much progress in structural design and fabrication can be expected. Pointing out that "costs of construction are now almost prohibitive," he forecast that "very unique methods will some day . . . be developed to do some of the things which are now being done by very expensive machinery."

Littlewood hopes to see savings in aircraft weight through the improvement of manufacturing methods. He said that Pratt & Whitney has admitted that an engine designed for transport service is not subject to the G-load limitations required of a military engine. As a result, he said, the manufacturers have been able to reduce the overall engine weight by about 700 lb. without changing the design of the compressor, combusters or the turbine.

Denny Defends CAB In Letter to Harris

Washington—Civil Aeronautics Board member Harmar D. Denny last week denied that Sherman Adams, chief presidential aide, attempted to influence the Board in the North American Airlines case.

In a letter addressed to Rep. Oren Harris (D., Ark.), Chairman of the House Subcommittee on Oversight, Denny labeled charges by Dr. Bernard Schwartz, former subcommittee counsel, that Adams had intervened in the case, as "completely false" and "worse than half-truths." Denny said that references by Schwartz to two letters written by Adams to Murray Chotiner, representing North American, implied that Adams may have improperly attempted to influence the Board in the enforcement proceeding against the now-defunct airline.

Denny emphasized "there was no pressure or suggestion from the White House as to the course the proceeding should take or the action that the Board should take" and added:

"There was simply a request for information—a request which, in the light of the serious charges which had been made by North American in its widespread campaign, seems to me to be a wholly reasonable one . . ."

North American went out of business early last year when the Supreme Court denied a petition for certiorari to climax a four-year struggle by the Board to clamp down on the carrier for a series of alleged violations of regulations.

In his letter to Harris, Denny denied he had suggested to Adams that "the way to delay the case was for North American to go into court and tie the case up by court proceedings." He added that the charges reach "the completely ridiculous conclusion that the Board was trying to sabotage its own enforcement action."

"The facts are . . . that the Board was insistent on continuing its enforcement action despite North American's attempts to suspend it," he said.

Denny said he has no recollection of ever talking to Adams about the case. He said that he had sent Charles Willis, White House staff member, a copy of a letter to Sen. Edward Thye (R., Minn.), explaining the procedures being followed in the case and added that the letter from Adams to Chotiner was "probably" based on material in the letter to Thye.

He accused Schwartz of ignoring the facts and added:

". . . It apparently did not occur to Dr. Schwartz that it is absurd to suppose that it was necessary for the Board to point out to North American or to Mr. Chotiner that the courts are available and that court action is one way to obtain a delay . . . In this connection, I would like to point out that North American needed no instruction in the fine art of appealing to the courts."

South African 707s

South African Airways will order three Boeing 707-320 long-range jets, Transport Minister Ben Schoeman announced recently. He said the order will be placed immediately.

The airline operates overseas routes to Europe and Australia in addition to its domestic regional services. Johannesburg-Amsterdam flight time with the jets would be about 10 hr. 51 min. against the present 21 hr. Jan Smuts International Airport is equipped with a main runway over 10,000 ft. long capable of handling aircraft up to 200 tons.

Russian Proposes Medium Transport

Moscow—Russian designer O. K. Antonov has called on the government to authorize construction of a "26-30-passenger airplane with excellent landing and takeoff characteristics in order to permit airline service between medium and small-size towns having poorly-equipped airfields." The craft would help fill the equipment gap between Antonov's seven-passenger Pchelka (Little Bee) light transport, which now is undergoing tests, and the large new Soviet turbojet and turboprop airliners, which seat a minimum of 50 passengers.

American Revamps Sales Department

New York—American Airlines will make a series of major revisions in the structure of its sales department April 1 when C. A. Rheinstrom rejoins the carrier as executive vice president-sales (AW Feb. 24, p. 36).

The new organizational pattern is designed to strengthen American's sales effort by placing all sales functions and customer services under one head. Changes include the establishment of a new Sales Service Department that will embrace a number of functions now handled by customer service.

Public Relations will now report to Rheinstrom but overall policy for the airline will continue to be directed by President C. R. Smith. At a later time, all reservation offices will report directly to sales. Airport duties will be redivided between operations and sales departments with a view toward placing ticket counter and other functions under sales.

C. R. Speers will serve directly under Rheinstrom as senior vice president. Divisions and titles under the new arrangement are:

Vice president, advertising; vice president, cargo sales; vice president, passenger sales; vice president, passenger sales service; assistant vice president, schedules; vice president, public relations; director, sales budgets; regional vice presidents.

Four divisions will be established under the Passenger Sales Services Department to be headed by G. M. Sadler. They are in-flight standards division, ticketing and terminal division, reservations division, customer correspondence branch and sales equipment research division.

Red China to Expand Civil Air Transport

Moscow—Communist China has ordered its Civil Air Fleet Administration to increase traffic 50-100% under the nation's Second Five-Year Plan (1958-62).

Development program also provides for introducing Soviet-built turbojet and turboprop aircraft on Red Chinese air routes. Present equipment consists mainly of Russian Il-14s, Il-12s and Li-2s.

During 1957, last year of the First Five-Year Plan, Communist China's "overall" commercial air traffic was three and one-half times the 1952 volume, according to an official report.

National to Construct Hydrant Fuel System

Construction of an underground hydrant fueling system for jet aircraft has been started by National Airlines at Miami International Airport.

Fueling system, first of its kind to be built at the Miami airport, will have a total delivery capacity of 3,000 gal./min. to supply four hydrants—two for jet fuel and two for piston engine fuel. When not in use, underground hydrants will be hidden with flush covers strong enough to support the 265,000 lb. weight of a DC-8.

Initially, 420,000 gal. storage tankage will be built at a cost of $100,000. This will be increased to a total capacity of 1,200,000 gal. at an additional cost of $200,000. Hydrant system, with its two miles of underground piping, will cost $500,000.

Fuel will be delivered from hydrant to plane by a small pumping truck. National estimates that in 1962, when its entire fleet of six DC-8s and 23 Lockheed Electra turboprops will be in full operation, annual fuel consumption at Miami will be approximately 70-million gallons.

SHORTLINES

▶ **American Airlines** will lease and operate a street floor ticket office in the new $70 million Time & Life Building near the corner of 50 St. and Avenue of the Americas in New York City. Occupancy of the new office is scheduled for sometime in the fall of 1959. American will continue to operate its ticket facilities at 9 Rockefeller Plaza.

▶ **Capital Airlines'** proposal to encourage group excursions by selling roundtrip tickets to groups of 25 or more at 160% of one-way first-class fares has been basically approved by the Civil Aeronautics Board. The new percentage rate would apply to flights scheduled to depart on Saturdays and Tuesdays for roundtrips that would be completed within seven days. Capital had asked for the right to separate individuals of such groups if operational problems required, but CAB voted that a group could not take advantage of the reduced fares if it were split into units of less than 10 persons. The CAB will permit the plan to become effective after Capital accepts the Board's modification.

▶ **Civil Aeronautics Administration** says no ground facilities to handle initial turbojet transport operations will be provided at Washington National Airport. In a memo to Lucius Burton, di-

Continental Viscount Undergoes Tests

First of 15 Vickers Viscount 812s to be delivered to Continental Air Lines recently made its first flight from the Vickers-Armstrongs Ltd. airfield at Weybridge, England. Type 812 series has 52-seat interior with rear lounge.

Continental Air Lines' first Viscount 812 is shown at test airfield at Wisley, England, where, together with a Vickers-owned 810, the certification program will be completed.

Rear lounge on Viscount 812 seats four passengers. The lounge seats will not be occupied during takeoff and landing as a safety precaution.

AIRLINE OBSERVER

► Boeing Airplane Co. is front-runner in the competition to provide Eastern Air Lines with 15 to 25 medium-range turbojet transports. In Seattle, Eastern president Capt. E. V. Rickenbacker said, "offhand, without any commitment, the Boeing 720 is closer to what we think we need than the Convair 880 is." Rickenbacker noted that Douglas is working on plans for a medium-range jet but added, "Boeing is out in front . . . in its ability to produce first." Rickenbacker wants to begin the medium-jet service in mid-1961. Initial order, which will be placed this year, will amount to $100 million.

► Watch for Western Air Lines to place an order for a fleet of Boeing 720s. The airline considers the medium-range aircraft about the right size for its route structure and wants the aircraft by 1961, a target date Boeing can meet.

► Post Office Department has determined that cost of transporting regular three cent mail by air is "running a bit less" than the cost of handling by surface transportation. The cost difference was disclosed as a result of a check made following the inauguration of the experiment involving the movement of regular mail over certain air routes on a space available basis. Testifying before a House Appropriations Subcommittee, E. George Siedle, assistant postmaster general, added that the cost by air has grown "even more favorable" because ". . . rail pay has been increased whereas there has been no increase in the compensation we are paying to the airlines."

► President Eisenhower has named a three-member fact-finding board to investigate the dispute between the International Assn. of Machinists and these airlines—Eastern, TWA, United, Northwest, Northeast, Capital and National.

► Air Line Pilots Assn. will refund a portion of dues to members as a dividend on surplus funds in excess of operating expenses and reserve requirements. Refunded dues will total $106,000 with individual refunds amounting to 5.22% of the dues paid by each member during 1957.

► Sicily will construct an $8 million international airport at Palermo to handle traffic on Europe-Africa and Orient-Atlantic routes. Airport will cover over 600 acres, include a 10,000 ft. by 200 ft. runway and will be completed in about three years.

► Trans-Canada Air Lines will replace all its DC-3 aircraft in eastern Canada with Vickers Viscounts by July 1.

► Swissair's Board of Directors will propose a 50% increase in the company's capital stock issue at a stockholders' meeting April 2. Proposed increase will raise capital from $9.8 million to $14.7 million.

► Observers are noting that Airways Modernization Board programming often is projected over a five year period although the interim agency has a legal life-time of but three years. Meanwhile, AMB is considering Atlantic City as a site for its test center; locations in Florida and Oregon also are being studied. AMB will be equipped with 20 civil and military aircraft so that flight experimentation tests for airways development can be conducted with virtually every type of aircraft now in use.

► Civil Aeronautics Administration is spearheading nation-wide program covering 20th anniversary of the Civil Aeronautics Act of 1938. All aviation agencies and associations are participating in the planning of the program which will be held during the week of June 23 but basic plans were formulated by the CAA several months ago. Feature of the program will be open house at all CAA facilities throughout the U. S.

► Aeroflot's first regular TU-104 service between Moscow and Vladivostok is being offered only once every four days until the end of March, when the flight frequency will be increased. Scheduled time on the 5,000-mile trans-Siberian route—including stops at Omsk, Irkutsk and Khabarovsk—is about 11 hours.

rector of the airport, CAA Administrator James Pyle said that airlines wanting to provide jet service to Washington National can use Friendship International Airport, pending completion of Washington's new airport at Chantilly, Va.

► **Delta Air Lines** reports declining traffic during the final months of 1957 and the first few weeks of 1958 has caused the airline to make a downward revision of the forecasted volume of 1958 operations. Delta has placed orders totalling over $500,000 with Collins Radio Co. for airborne weather radar and communication-navigation equipment with deliveries scheduled to begin this month. The order covers equipment, spares and parts for the fleet of Douglas DC-8 and Convair 880 jet transports ordered by Delta.

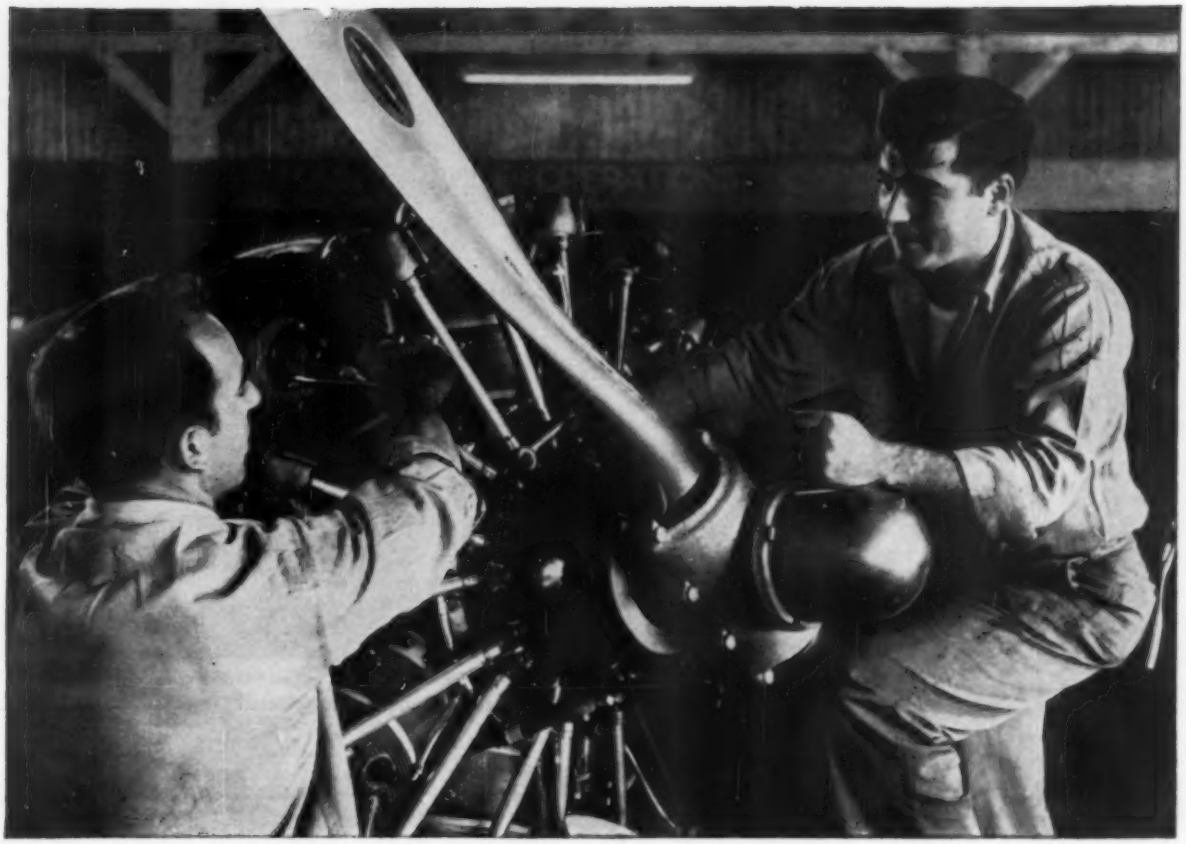
► **Ethiopian Airlines** flew a record 87,605 revenue passengers 39,192,000 revenue passenger miles during 1957.

► **Flying Tiger Line** reports it flew 82,986,089 ton miles during 1957, 23% above the 1956 figure. The airline attributed the gain to introduction of the 12 new Lockheed Super-H Constellations during 1957.

► **International Air Transport Assn.** has assigned the Brussels World Fair a place on the world network of scheduled airlines. The heliport on the fairgrounds will be known as the "Bruxelles World Exposition 1958 Heliport" with the official designation letters "BXP." The heliport will serve passengers coming to the fair from centers in Belgium, Holland, France and Germany.

► **North Central Airlines** has filed applications with the Civil Aeronautics Board for approximately 825 route miles connecting three U. S. cities with points in three provinces in Canada. The airline wants routes between Minneapolis-St. Paul, Minn., and Winnipeg, Manitoba; Detroit, Mich., and Toronto, Ont., and Minot, N. D., and Regina, Saskatchewan.

► **Trans World Airlines** has begun construction of a $5 million maintenance facility and administration building at Los Angeles International Airport. The new center will consist of a 490-by-390 ft. hangar, an adjacent administration building and a separate garage and ground maintenance building. The hangar will be capable of housing six Boeing 707 or Convair 880 jet transports. Surrounding the hangar is more than one million sq. ft. of pavement, already poured, for parking and servicing positions for 21 aircraft.



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Use new Gulfpride Aviation Oil Series D, the detergent oil, or Gulf Aircraft Engine Oil, the straight mineral oil. Either way, you'll be keeping your engine clean, and playing it safe.

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FIRST PHOTOS show how stainless nose cone of Explorer I satellite was formed by Floturn cold rolling method developed by Lodge & Shipley Co. (left). At right, technician uses a Vernier height gage to check nose length during forming process.

Blunt Stainless Steel Nose Cone Indicates

By George L. Christian

New York—Army's Explorer satellite nose cone, a stainless steel unit 12.221 in. long and 6.128 in. in diameter, is designed with a blunt nose indicating that heating problems are encountered during flight to orbiting altitude.

Nose radius is 1.500 in. Cone's wall thickness ranges from .094 in. in center to .017/.013 in. on sides.

Shape serves as a nose cone both for the entire Jupiter-C, four-stage missile during initial acceleration and for the satellite as its orbits around the Earth.

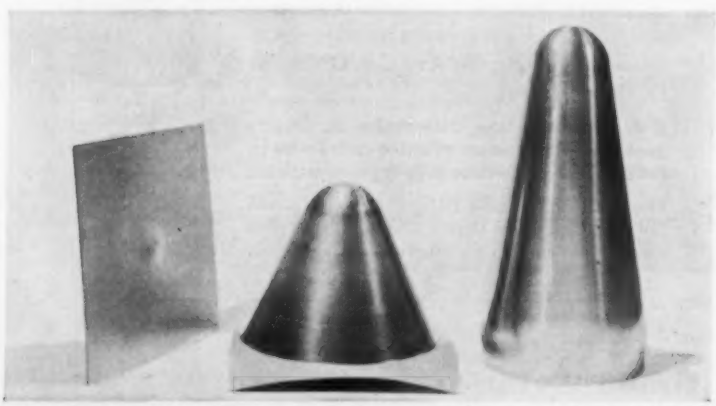
At least 40 cones have been manufactured to date by Lodge & Shipley Co., Cincinnati, Ohio, under contract to the Army Ballistic Missile Agency, which has received 30 units, and Jet Propulsion Laboratory of the California Institute of Technology, which received 10 cones. Both organizations were responsible for the development of Jupiter-C and Explorer I (AW, Feb. 10, p. 28).

First satellite, weighing 30.8 lb., was launched on Jan. 31; a second, more highly instrumented Explorer, also weighing 30 lb., will be launched soon.

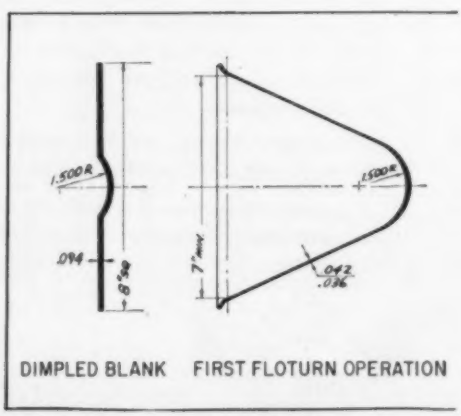
Stainless steel was selected as the metal best suited for nose cone construction because of its high tensile strength, even when weight restrictions demand the use of thinnest possible gages. Other desirable qualities are high resistance to corrosion and temperature extremes.

Cone is made of type 430 stainless —the same grade used by the automotive industry for car trim.

Weight of the complete unit ready



THREE forming stages of Explorer I's nose cone: stainless steel blank .094 in. thick is dimpled in the middle; first Floturn operation gives basic shape; cone's final form.



FIVE STEPS used by Lodge & Shipley to transform an 8 in. square stainless steel blank into a finished

TECHNICAN checks wall thickness of nose cone with a Vidigage ultransonic probe. Streak of light on instrument panel in rear indicates wall thickness on the chart.

Satellite Heating Problem

to assemble to the instrument package is 13 oz. It is attached to the satellite by 16 4-in. bolts.

Astronomers estimate that the satellite, during its orbiting, is being subjected to temperature extremes of −200C (−392F) when it is in the Earth's shadow, to 1,000C (1,832F) when subjected to direct solar radiation. Figures are based on the satellite's average color being grey and average altitude of about 1,000 mi.

Highly reflective strips of zirconium oxide are used on the outside of the satellite to avoid excessively high temperatures. Fact that the satellite is spinning gives it an average color of grey.

Explorer I is circling the Earth at 18,470 mph., in an elliptical orbit whose apogee is 1,587 mi. and perigee is 219 mi.

Nose cone is cold-formed by a Lodge & Shipley-developed process called Floturn.

With this process, a metal blank is inserted between a roller and a back-up mandrel. Action of the roller, which is actuated either mechanically or hydraulically, displaces the metal parallel to the centerline of the part being formed. This differs from a cold rolling mill which displaces the metal in a longitudinal direction, causing a spiral pattern as the work revolves.

However, effects of Floturn on the metal are similar to those of cold rolling.

Granular structure is compressed and refined, yet flow lines are unbroken, adding considerable strength and a hardness to the shape. No potential or actual points of metal failure are produced by the process and any stresses that are produced can be completely relieved by standard annealing treatment, according to the manufacturer.

Process also produces a smooth surface on the metal being worked. Surface finish on the nose cones is as low as 4-5 microinches.

Three production steps used to produce the satellite's stainless steel nose cone are:

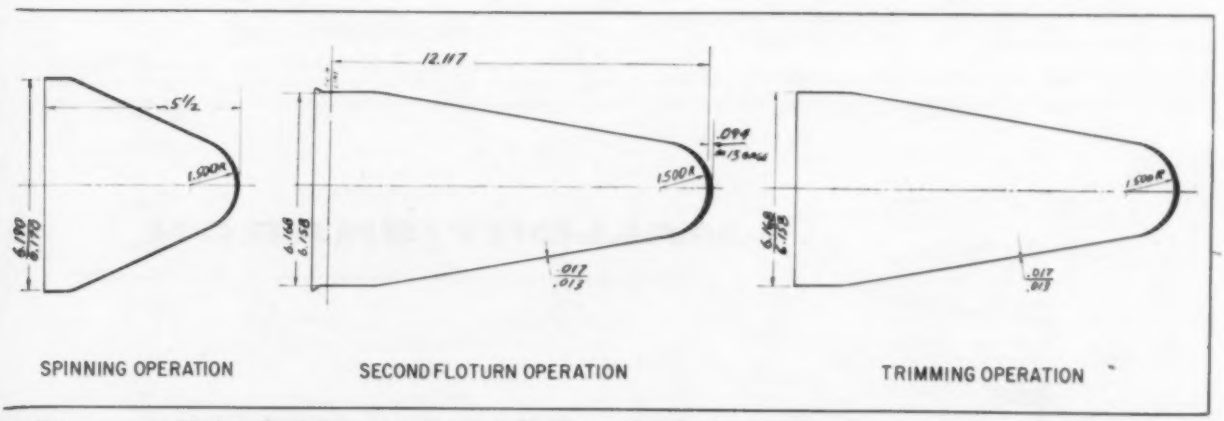
• **Square, Type 430** stainless steel blank .094 in. thick is dimpled in the center to serve as a locating point for a 25 deg. mandrel on first Floturn operation. Basic nose cone configuration is obtained by this operation.

• **Conical shape's base** is trimmed and cone is annealed to relieve stresses.

• **Cone is again** Floturned to completed form except for again trimming the base.

Final testing of the nose cone's wall thickness is accomplished with a Vidigage ultrasonic vibration testing machine.

Trend to use of stainless steel for rocket and satellite nose cone applications is indicated by the fact that before Explorer I's nose cone was manufactured of the metal, the instrumented rocket used in Project Farside also used stainless steel. Farside rocket soared to some 4,000 mi. above the Earth.



satellite nose cone. Blank is dimpled in center to serve as locating point for 25 deg. mandrel for first Floturn shaping operation. After first shaping operation, cone is trimmed, then given a spinning operation. This is followed by a second Floturn operation.

Largest Special Metals Company Formed

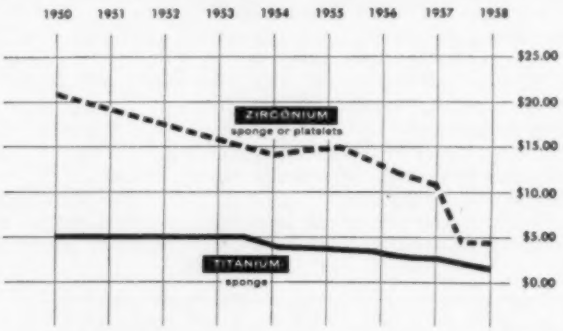
MALLORY-SHARON NOW INTEGRATED PRODUCER OF TITANIUM, ZIRCONIUM, SPECIAL METALS

Mallory-Sharon Titanium Corporation has broadened its scope in the special metals field with acquisition of all the titanium and zirconium sponge production facilities of National Distillers & Chemical Corporation, plus full ownership of Reactive Metals, Inc., formerly owned jointly by Mallory-Sharon and National Distillers.

Our new name is Mallory-Sharon Metals Corporation. Our products include titanium, zirconium, and hafnium in sponge form and in a broad range of mill products including sheet, plate, rod, bar, billets, etc. Planned for the future are other special metals.

LOW COST PROCESS—Now a fully integrated producer, Mallory-Sharon will use the new sodium reduction process for making titanium and zirconium sponge. This process is believed to be the lowest cost method developed to date for this purpose, and produces metal of unusually high ductility. It will contribute to making titanium and zirconium economically attractive in more and more applications.

WHAT THIS MEANS TO YOU—Mallory-Sharon's leadership in the special metals field will mean continuing improvements and importance to these metals. In addition to titanium's broad use in aircraft and missiles, and zirconium's in the nuclear field, both metals provide exceptional corrosion resistance—offering lower costs in a broad range of processing and industrial applications. Let us help *you* design ahead with these new metals.



Regular price reductions in titanium and zirconium sponge have also been reflected in lower prices for mill products. This trend shows the wisdom of evaluating titanium and zirconium now for your new products.

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Integrated producer of Titanium • Zirconium • Special Metals

Douglas Reveals Mach 9 Aircraft Details

Los Angeles—Details of design philosophy evolved by Douglas Aircraft Co., El Segundo Division for its 1953 proposal to Navy for D-558-III research aircraft, plus material which figured in Division's proposal in X-15 competition of about one year later, were outlined here recently by Kermit Van Every, chief of aerodynamics.

Highlights of the early proposal for follow-on to the D-588-III Skyrocket were:

- **Original** goal of 1 million ft. altitude, velocity close to that of escape, which was modified to a goal of 750,000 ft. and speed of Mach 9.
- **Use of blunt leading** edge airfoil as one facet of attack on aerodynamic heating problem.
- **Refinement of aerodynamic** flight controls for control in atmosphere, use of mono-propellant jet reaction controls for out-of-atmosphere control.

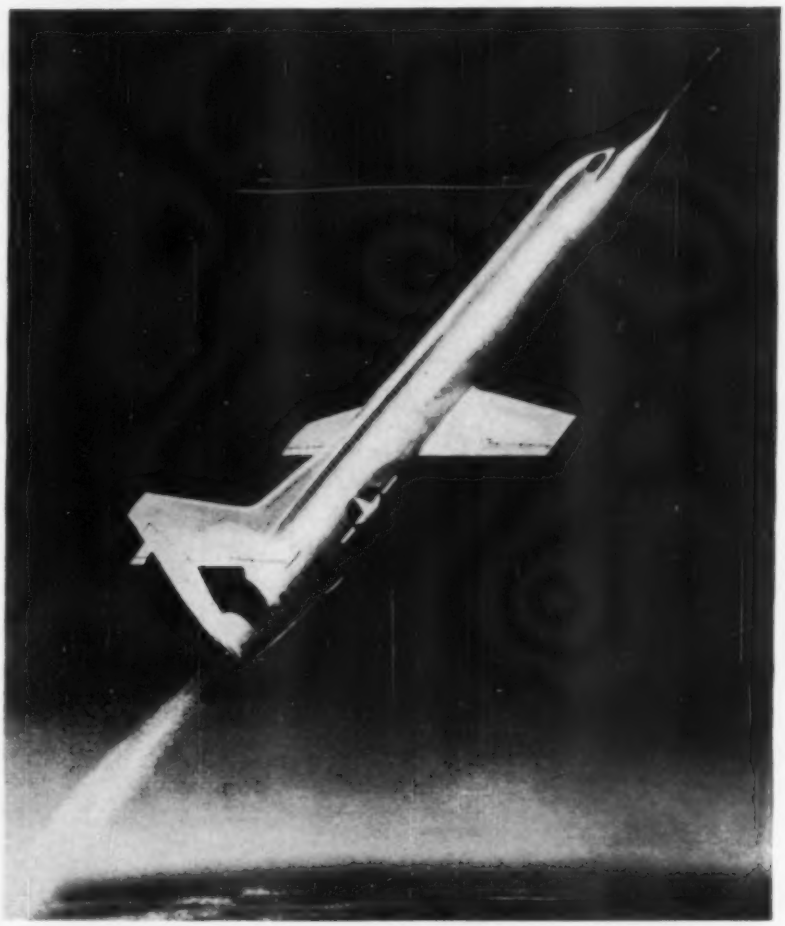
Abandon Altitude Goal

Early in their work, Douglas engineers abandoned the extreme altitude goal since it was not deemed reachable without a rocket booster system, and it was considered best to stick to the "mother ship" launching system.

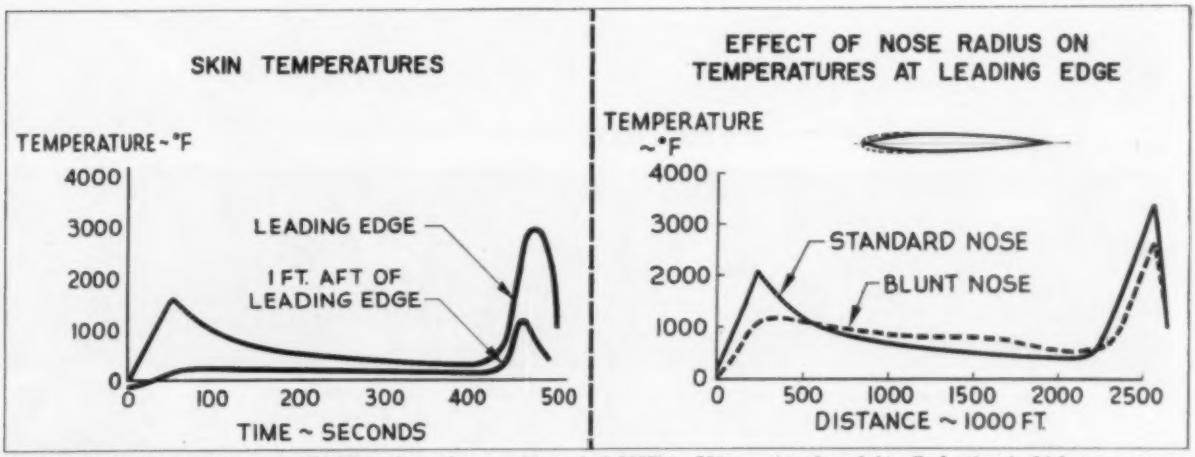
Additionally, calculations indicated that accelerations involved in re-entry from the more extreme altitudes would exceed the limitations of the pilot, precluding taking full advantage of even the mother-ship launching system's altitude capabilities.

Materials taken into consideration were the high temperature super alloys, capable of withstanding aerodynamic heating in steady state rather than transient conditions.

Flight path investigation showed a 38 deg. angle at burnout was optimum



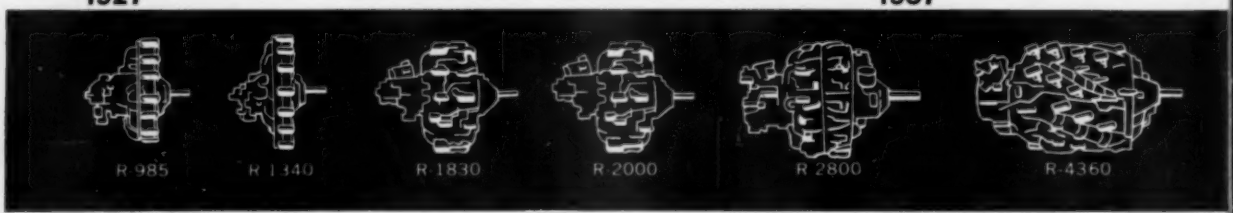
STRAIGHT WINGS characterize this Douglas D-588-III Skyrocket research aircraft first proposed in 1953 to U. S. Navy. Project was dropped because of lack of funds. Artist's conception shows design philosophy of blunt leading edge shapes to reduce skin friction and resultant aerodynamic heating. Plane would be fitted with mono-propellant jet controls for upper atmosphere flight.



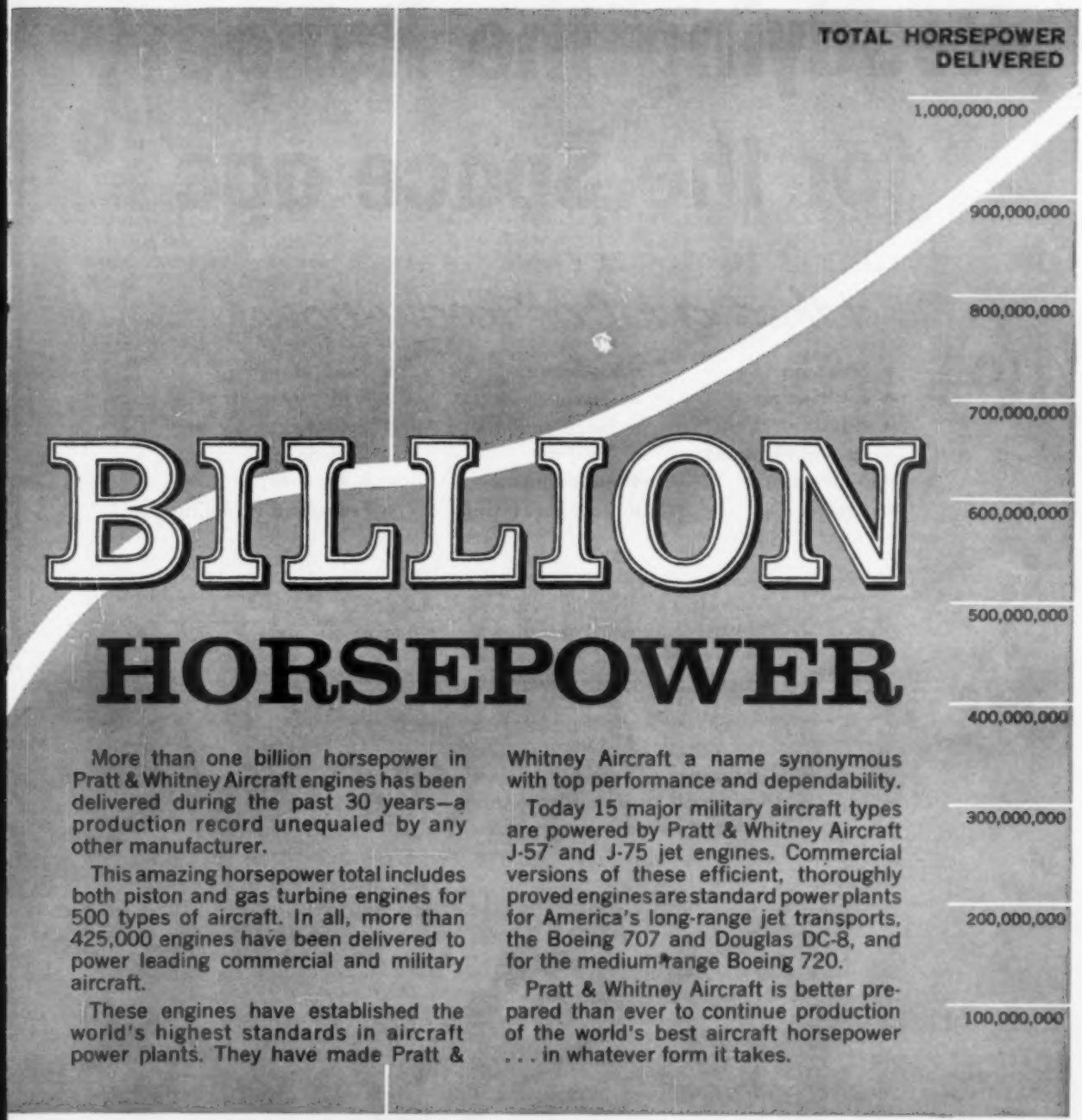
AERODYNAMIC HEATING of D-558-III leading edges would reach 3,000F in 500 sec. (graph at left). Reduction in high temperatures is marked aft of leading edges. At right, blunt nose configuration temperature effect (dotted line) is compared to standard nose.

ONE

1927 1937



These engines are typical of the major power plants which have been designed, developed and produced by P&WA during more than 30 years for 500 different aircraft types.



BILLION HORSEPOWER

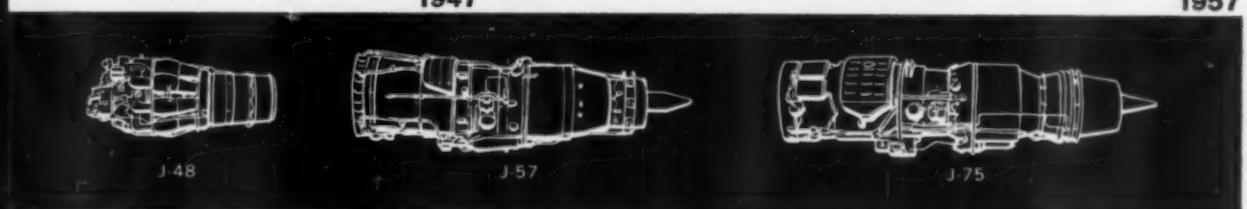
More than one billion horsepower in Pratt & Whitney Aircraft engines has been delivered during the past 30 years—a production record unequaled by any other manufacturer.

This amazing horsepower total includes both piston and gas turbine engines for 500 types of aircraft. In all, more than 425,000 engines have been delivered to power leading commercial and military aircraft.

These engines have established the world's highest standards in aircraft power plants. They have made Pratt & Whitney Aircraft a name synonymous with top performance and dependability.

Today 15 major military aircraft types are powered by Pratt & Whitney Aircraft J-57 and J-75 jet engines. Commercial versions of these efficient, thoroughly proved engines are standard power plants for America's long-range jet transports, the Boeing 707 and Douglas DC-8, and for the medium-range Boeing 720.

Pratt & Whitney Aircraft is better prepared than ever to continue production of the world's best aircraft horsepower . . . in whatever form it takes.



Pratt & Whitney Aircraft

Connecticut Operations—*East Hartford*
MAJOR BRANCH PLANTS—Meriden, North Haven, Southington
Florida Operations—*West Palm Beach*

Division of UNITED AIRCRAFT CORPORATION, East Hartford, Conn.

Readying the Range for the Space age

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- Engineering
- Administration
- Communications
- Meteorology
- Marine
- Electronics
- Optics
- Procurement & Supply
- Maintenance
- Data Processing
- Food, Housing & Medical
- Security
- Clearance & Recovery
- Propellant Handling

Since July 1953, Pan Am, with RCA as its principal subcontractor, has been planning, instrumenting and operating the 5000-mile test range for the Air Force Missile Test Center at Cape Canaveral, Florida.

A pioneer for thirty years in the fields of technology, construction and offshore operation—in war and in peace—Pan Am's resources are dedicated to this most vital task of continuous range readiness.

PAN AMERICAN

GUIDED MISSILES RANGE DIVISION

Patrick Air Force Base, Florida

for a starting point, would impose 10.2G accelerations at re-entry pullout, would achieve the 750,000 ft. altitude and velocities of the order of 8,870 fps. Maximum angle obtainable was figured at 84 deg., but resulted in too high accelerations at re-entry pullout.

Limits of what was termed the "corridor of continuous flight" were calculated, using a minimum speed of 170 mph. as one limit for planes utilizing aerodynamic lift, while the other side of the corridor was bounded by aerodynamic heating at high Mach numbers.

In configuring the D-558-III, Douglas proceeded on the philosophy that bluntness, and its effects on boundary layer, would contribute to reduction in aerodynamic heating. Additionally, the time at elevated temperatures was calculated, results showing an interval of the order of 50 sec. at levels approximating 2,000F.

Other considerations were that bluntness (a modified Clark Y airfoil with elliptical nose section was envisioned) would play no part in the craft's performance in the out-of-atmosphere regimes it was intended to investigate. The bluntness would keep landing speeds in the lower ranges, rather than those in higher class resulting from thin supersonic airfoil shapes.

Other out-of-atmosphere considerations were that plane's capabilities in this region would be the product of thrust weight ratio rather than configuration, due to absence of aerodynamic drag.

Heating Probe

Aerodynamic heating investigation covered, in addition to blunt shape contribution to heat reduction, the possibilities of using insulation coatings on surfaces in combination with suitable materials. Research into insulation materials and techniques was urged. It was noted that while highest temperatures were reached at wing leading edge (stagnation point), more typical values were obtained one foot behind the leading edge, and were part of its short durations mentioned earlier.

A strong part of the proposal covered thorough research into blunt shapes to make wave drag a large portion of total drag, reducing skin friction and its associated aerodynamic heating. The report noted that much research remained to be done in order to precisely predict bluntness effects on boundary layer to the level required for building an aircraft wing on this basis.

Stability and control problems in the atmosphere were termed mostly exaggerated forms of known phenomena encountered on aircraft then flying in the low supersonic regions. While the D-558-III configuration had the horizontal stabilizer located above wing chord line, further investigation showed that optimum location for the X-15 competition entry would be on or very close to an extension of the wing chord line.

Adequate apportionment of vertical stabilization surface above and below fuselage (ventral fin) also was seen for the entry into the X-15 competition.

Problems foreseen in the later research vehicle included such things as weightlessness, other physical phenomena, but it was mentioned that perhaps one of the greatest would be the "breakoff effect," a feeling of detachment from Earth and reaction varying in individuals from anxiety, loss of initiative to exhileration.

Solid Propellant Growth Cited In Formation of Oxidizer Firm

Hooker Electrochemical Co. and Foote Mineral Co. have added another name to the growing list of new firms in the missile propulsion field (AW Jan. 20, p. 34). Called HEF Inc., the new firm will specialize in production of perchlorate oxidizers for solid propellants, specifically ammonium perchlorate.

The expected growth in solid propellants was given as the reason for the formation of the jointly owned company. Another reason, not announced, is the growing interest of solid propellant producers in a particular perchlorate oxidizer, lithium perchlorate.

Until now, Hooker has not supplied any propellants to missile field, even though the company is a prime producer of sodium perchlorate and potassium perchlorate. Foote, basic in lithium with its ore deposits and production facilities, has had some research and pilot plant production experience with both ammonium perchlorate and lithium perchlorate. (At one time, Foote had a contract to supply the military with lithium perchlorate for experimental purposes). By combining ore deposits, production facilities and know-how in HEF Inc., both companies hope to attain a leading position as suppliers of ammonium perchlorate and lithium perchlorate.

At present, American Potash & Chemical Corp. is the sole producer in this country of ammonium perchlorate, which the company has been supplying to the missile program. Like Foote, American Potash also has had some experience in the research and small scale production of lithium perchlorate and has a pilot plant available for manufacturing the oxidizer.

Should a large demand for lithium perchlorate develop, however, it will require more than a simple scaling up of present pilot plant facilities. In the past, both Foote and American Potash reportedly produced lithium perchlorate by a non-commercial method, reacting lithium hydroxide with another perchlorate such as sodium perchlorate or postassium perchlorate. With increased demand, however, production economics will probably force both companies to make the oxidizer by a more direct method, such as electrolysis of lithium chloride.

Principal attraction of lithium perchlorate for the composite propellant manufacturer is its percentage of available oxygen—60% by weight compared with 46% for potassium perchlorate and 25.2% for ammonium perchlorate. On a density basis, the figures are even more favorable. One cubic foot of lithium perchlorate contains 85.6 lb. of available oxygen; potassium perchlorate, 52.5 lb.; and ammonium perchlorate, 28.2 lb.

In a composite solid propellant engine where the oxidizer accounts for 70 to 80% of total propellant weight, this can mean a significant increase in overall efficiency and performance. The motor and missile can be made much smaller or, for the same size missile, useful propellant load and range can be increased.

Less significant is the slight gain in performance that can be realized from the complete burning of the fuel in those instances where a slight excess of fuel is now required to bind the composite solid propellant together.

Too, there is the matter of lithium's lower atomic weight (6.94) compared with potassium (39.10) and the ammonium radical (18.00). This will mean lower weight exhaust products and, perhaps, noticeably higher specific impulse.

Napier Rocket Engine Confirmed for P.1B

London—Government announcement to fit the Napier Double Scorpion rocket engine as an optional, additional powerplant on the English Electric P.1B confirms the prediction made by AVIATION WEEK (AW Sept. 30, p. 50).

Engine will enable the aircraft to operate either as a mixed powerplant or a pure jet fighter, according to operational requirements. Engine is fitted in a specially-designed jettisonable pack to the underside of the fuselage. Pack contains high-test peroxide and is designed for safe handling and refueling either with the pack slung or detached. Kerosene for the engine will be drawn from the existing fuel tanks.

LINK
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JAPAN AIR LINES PICKS LINK

Now JAL forms another link in the world-girdling chain of great air lines buying Link simulators for their jet training needs.

Japan Air Lines has ordered an electronic simulator from Link Aviation, Inc., to train flight crews for its forthcoming fleet of DC-8 jet transports. By "flying" the simulator, JAL's experienced pilots will in effect be pre-flying the huge DC-8 . . . long before the first jet liner joins JAL's Courier Fleet from the U. S. to the Orient via Hawaii.

Using the simulator, Japan Air Lines crews will receive such complete and realistic training that the transition to the actual DC-8 will be smooth and natural.

As they have in the past, Link's electronic simulators train today's crews thoroughly, economically . . . make tomorrow's flights better and safer.

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Fuselage Hoops May Stop Crack Growth

Farnborough—Technique for reducing crack propagation in pressurized cabins without an appreciable weight penalty has proved effective in full-scale cabin tests at the Royal Aircraft Establishment.

Based on the use of narrow metal hoops girdling the fuselage skin at 10-in. pitch or interval, the technique was developed by Dr. David Williams, deputy senior scientific officer at RAE and a leader in the original Comet crash investigations.

Dr. Williams told AVIATION WEEK that the technique has implications which could revolutionize present thinking in pressure cabin design. He said the possibility of catastrophic failure with the hooped fuselage can be virtually ruled out.

Hooping the fuselage, he said, cuts the need for careful and frequent crack inspection. The system calls for no changes in existing stringer-frame configurations, strengths and stiffnesses.

Spaced 10 in. apart, the bands or hoops lead to an overall—not a local—reduction in skin stress on the order of 33% with the band-skin configuration tested. This is because the radial restraint exercised by the bands on the pressurized cabin does not fall off between the bands as it does with wider spacing of restraints. Due to the reduced stress, thinner skins can be used for the same skin stress and the weight saved compensates for the weight of the bands, Williams said.

Crack Propagating Theory

Discussing structural safety the tests are claimed to demonstrate, Dr. Williams also disclosed to AVIATION WEEK that since these tests he has formed a theory which accounts for all the hitherto unexplainable features in the mechanism of crack propagation which have been reported by all workers in this field.

His investigations of a large number of results already published have indicated that the results all conform to the theory of dimensional analysis applied to geometrically similar structures.

His theory means that the designer can now refer to a chart for exact predictions of crack propagation in any structure. His theory is still being circulated at the RAE and there has been no time for his report to be granted the establishment's authority.

Significant crack-stopping characteristics arising from the use of bands at 10-in. pitch is the fact that a fatigue crack stress concentration is not able to reach the critical value which the crack self-propagates at very high speeds.

According to Williams, fatigue crack reaches a critical length which depends solely on the size of the structure and the skin stress.

When it reaches this length the stress concentrations are such that the crack self-propagates at one-third the speed of sound in steel.

In a conventional cabin, 10-ft. diameter, the critical length is 8 in. Up to the critical length, the crack develops relatively slowly under repeated applications of the pressure load. As the crack develops, the load it sheds is accommodated by a stress concentration at the ends of the crack.

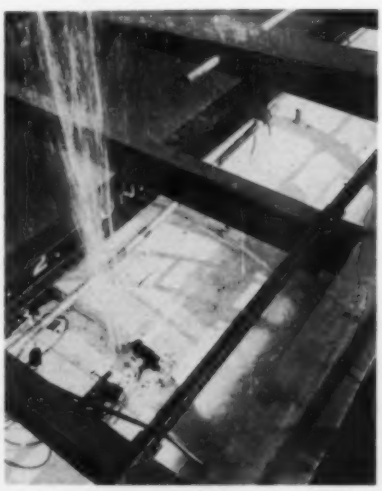
Williams asserts that, depending on the size of the cylinder, for any length of crack there is a unique stress which will cause it to self-propagate.

The results show:

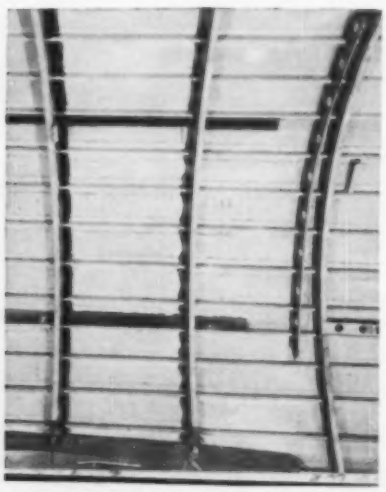
(1) A 10-in crack can go safely undetected for a whole year in service;

(2) A nose-to-tail split in the skin would not lead to structural failure as the bands are designed to accept the full circumferential cabin load;

CATASTROPHIC failure of Comet I jet transport test fuselage occurred only after metal bands and 20 in. of skin had been sawn through. Test bands were 1¼ in. wide and 0.1 in. thick and were riveted to outside of Comet skin.



WATER sprays outward from 5-in. crack between hoops on Comet I pressure test. Hoops kept crack from spreading further.



CONVENTIONAL stringer and frame was not changed for hoop tests. Cabin weight also was not appreciably changed by hoops.

T-38 Undergoing Rocket Sled Tests

Advanced state of development of USAF's T-38 supersonic training plane is demonstrated in this view of prototype being built by Northrop Aircraft, Inc., at Hawthorne, Calif. Fuselage has been shipped to Edwards AFB, Calif., for high speed rocket sled testing.

(3) A 20-in. crack extending across two panels together with fracture of the intervening band can be safely tolerated.

Comet I Cabin Used

The water tank tests on which Williams tested his theoretical analysis were carried out on a Comet Mark I cabin which had already undergone extensive fatigue testing trials. The results have just been published in a report, C. O. No. 357.

The bands were 1¼ in. wide and 0.1 in. thick. These were lightly reduxed and riveted to the outside of the skin.

No other structural alterations were needed as the original stringers pitched at 5 in. and the frames at 20 in. followed current practice, while the skin on this particular Comet fuselage was already 30% thinner than that now used—22 S.W.G.—as against 19 S.W.G.

The degree of resistance of the hoop structure to crack propagation is revealed in the histories of the following tests. It took 300 pressure cycles of 8¼ psi. to extend a 5 in. saw cut across the remainder of the panel (the saw cut starting from one band), and 1,150 further pressurizations failed to propagate the crack under the bands to their outside edges. This number of reversals is considered equivalent to one year's service of 5,000 hr.

In another test, a full panel crack was further extended by 1-in. saw cuts into the adjacent panels and another 1,100 reversals only succeeded in extending the crack a further inch each way.

To demonstrate band failure, a full 10-in. crack was extended by sawing through a band. When nearly severed, sawing was stopped and cyclic pressurization commenced. When the band failed, the crack shot across to the next band which completely arrested the fast-running crack. Crack was then 20 in., long, and it was not until a second band was sawn halfway through that catastrophic structural failure occurred.

Action of the straps in partly restraining the skin-stringer combination from expanding radially under pressure reduces the hoop stress in the skin. In his theoretical analysis, Dr. Williams shows that the restraint not only depends on the stiffness of the restraining element itself but also on the ratio between the bands, where it reaches a minimum, depends only on pitch.

At 30 in. pitch, restraint midway between bands falls to zero, and the skin stress at that point assumes the same value as it would in a totally unstiffened cylinder. For a 20 in. pitch, as is commonly used for frames, the restraint midway between bands increases to half the value at the bands.

But when the pitch closes to 10 in. the restraint midway between bands then becomes equal to that at the bands themselves. This leads to a uniform reduction in skin stress along the fuselage so that the amount of materials formerly in the skin can be distributed between the skin and the straps. The Comet cabin was equivalent to reducing the weight of the skin by one third and using it for the straps.

Conventional former-frames also are obliged to offer a degree of radial restraint by virtue of their contact with the skin. But with conventional frame-pitching, this restraint is largely local with a minimum vale between the frames, and no account is taken of the stress reductions arising from it. The design function of the frames is solely to stabilize the skin so that the fuselage can stand beam loading.

Stringer Section Important

The importance of the bridging role assumed by the stringer in this construction was not appreciated at the time of the experiments, Dr. Williams admitted. The influence of the stringers has since been emphasized in some tests completed by a manufacturer only a few days ago.

In these tests, which were in part to verify Williams' restraint theory independently, it was found that irrespective of pitch, the frames exercised a strictly local restraint which extended no more than an inch or two beyond it.

Cause of the discrepancy, it was discovered, was the use of Z-section stringers with flanges perpendicular to the webs instead of the top-hat section used on the Comet. Lack of bending stiffness of the Z-stringer, explained Williams, was the cause of the ineffectiveness.

The stringers "quietly twisted" under load because the center of sheer was offset in such a section.

Once a crack has developed its critical length of about 8 in., the Farnborough tests tend to show, the moment

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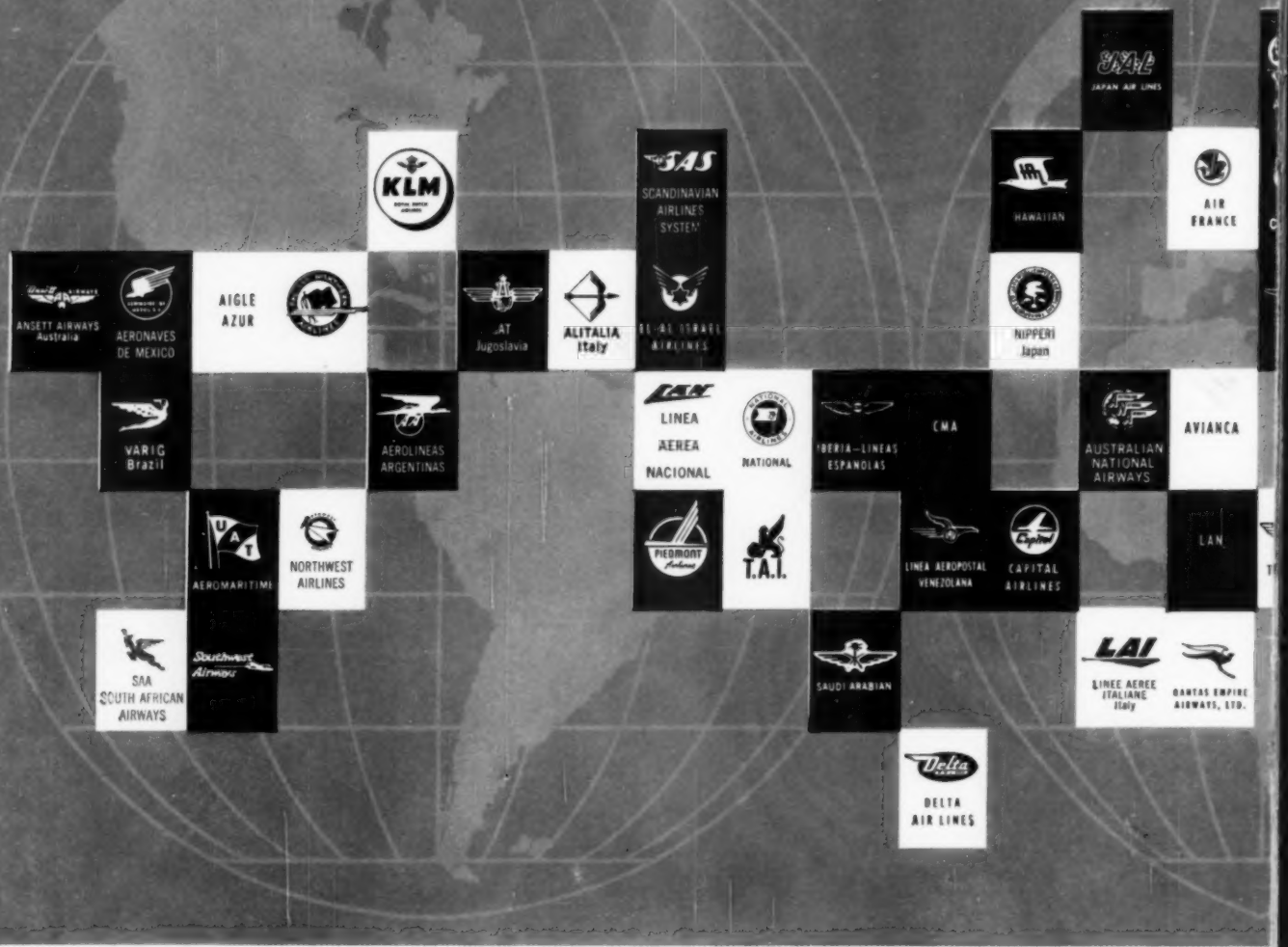

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880 Skin Tested

Crack propagation resistance in aluminum alloy skin of the Convair 880 jet transport is tested with a hydraulic device that puts longitudinal stress on fuselage section. Growth rate of a crack induced in the test section is measured while fuselage is under stress. Sample, a section above the windows near the wing, is pulled apart by hydraulic rams and forced apart by internal air and water pressure. Total longitudinal stress is 350,000 lb., which elongates the section about .2 in. during the test. Even after a 4 in. saw cut was lengthened to 20 in., Convair reports, the structure did not fail. Engineers found that prolonged cycling of pressure and release of pressure was necessary to obtain major crack growth in the .10 in. aluminum alloy skin. With saw cuts of less than 4 in., cracks could not be lengthened appreciably, the firm reports.

of disaster for a conventional aircraft has arrived.

At that point the crack will self-propagate and a swiftly running crack is not likely to be arrested by conventional frames. It could well reach from end to end of the cabin skin and take only a few milliseconds.

According to Williams, the relatively flimsy frames adjacent to the cracked panel are not able to take the load shed by the panel, and catastrophic structural failure ensues. The extremely short time taken for the crack to spread affords little time for the high energy in the compressed air to dissipate as the crack progresses. Consequently, a totally split cabin remains exposed to most of the original pressurization load.

With straps at 10-in. pitch, the whole mechanism leading to this type of failure is frustrated, Williams argues. The crack is never able to run because the stress concentrations normally associated with the crack are progressively reduced by the presence of the bands as the edges of the crack approach them. Consequently, when the crack reaches a length which would be critical in an un-hooped fuselage, the stresses, due to the presence of the bands, are not sufficiently high to cause it to self-propagate.

Furthermore, should the crack in a strapped fuselage spread underneath all the bands throughout the fuselage, catastrophic failure would not occur as the bands are fully able to accept the skin loads. At the same time the air would be forced to expand to a large number of small orifices represented by the gaps between adjacent straps. This fact minimizes the local damage caused by the air expanding and prevents development of huge opening which could produce extensive fragmentation and tearing in the area.

Due to preoccupation with current military research, wind-tunnel tests to establish the drag caused by straps have been delayed. But a small-scale preliminary model test of a nose section indicates a total drag of the order of 100 lb. Williams said that the drag is so slight that it would be impracticable to measure it in flight trials.

Some British manufacturers have begun experimenting in Britain with straps, Williams revealed. But at the moment, he said "the more conservative are objecting to the system on purely aesthetic grounds." This, he indicated, was apparent at a recent committee meeting of government and industry structural experts. There is evidence of a continuing policy of beefing up the frames, closing the frame pitch, thickening the skin so that stresses are lowered and crack propagation rates dropped, together with a more rigid visual inspection routine.

Dr. Williams was forthright about condemning such a policy. He told AVIATION WEEK that he "deprecates the use of frames as crack-stoppers." The deliberate strengthening of frames so they can offer effective radial restraint on the cabin puts the skin-frame rivets in considerable tension, he said. This condition he dismissed as "wanton violation of one of the first principles of engineering construction."

In addition to the primary circumferential in such frames, due to the radial expansion loads, Williams established in his theoretical analysis that there are heavy secondary stresses due to:

- **Extensive cutouts** for stringer connections.
- **Reluctance of the inner flange** and web to accommodate the same radial expansion as the outer flange.

He emphasized that a structural element of all these adverse and complex stress distributions was an entirely undesirable agent to act as a last line of defense in a crack-stopping situation.

These objections, he said, were quite apart from the weight handicap involved in using frames as crackstoppers. Williams rejects as sheer complacency the premise that visual inspection combined with thicker skins is an adequate safeguard against cracks developing. He said this fails to allow for the development of accidental cracks either in the air or on the ground that could lead to an 8 in. crack.

Flexible Tail Turret Designed for B-58

Convair B-58 is being equipped with a flexible cone tail turret mounting a General Electric M-61 Vulcan rotating cannon. The 20 mm. defensive weapon can fire 7,000 rounds per minute.

Design of the tail turret installation presented some problems for Convair. A bubble-type turret would create too much turbulence and, therefore, too much drag in a supersonic aircraft like the B-58. A conical turret would be

CONVAIR B-58's flexible cone tail turret mounts Vulcan 20 mm. rotating cannon.

V | *This is the fifth of a series of advertisements dealing with basic facts about alloy steels. Though much of the information is elementary, we believe it will be of interest to many in this field, including men of broad experience who may find it useful to review fundamentals from time to time.*

When Should Alloy Steels Be Ordered to Hardenability?

What is hardenability and how does it differ in carbon and alloy steels?

Hardenability can be defined as the capacity of steel to develop a desired degree of hardness, usually measured in depth. It is produced by special heating and cooling. Carbon steel, except in small sections, will normally harden to a depth slightly below its surface, while alloy steel can, under certain conditions, harden uniformly through its entire cross-section.

Surface hardness obtainable after quenching is largely a function of the carbon content of the steel. Depth hardness, on the other hand, is the result of alloying elements and grain size, in addition to the carbon present in the steel.

In general, where hardenability is the prime consideration, it is not too important which alloy steel is used, just as long as there is sufficient carbon present to give the prescribed hardness, and enough alloying elements to quench out the section. We might mention here that it is not considered good practice to alloy a small section excessively, since too free a use of alloying elements adds little to the properties and can, in some instances, induce susceptibility to quenching cracks.

There are, of course, numerous cases where factors other than hardenability must be considered; such factors as low-temperature impact, heavy shock, creep-resistance, and the ability to resist temper brittleness. Through-hardening, therefore, is not always desirable. For example, shallow hardening is often necessary in shock applications, because a moderately soft core is essential.

Our metallurgists will gladly explain where it is advantageous to order alloy steels to hardenability, and where it is preferable to order by analysis. They will also give you any help you may require in connection with heat-treating and machining problems.

And when in need of steels, remember that Bethlehem manufactures the entire range of AISI standard alloy grades, as well as special-analysis steels and all carbon grades. We can meet your needs promptly.

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Bell Readies XV-3 for Conversion

Bell Helicopter Corp. chief test pilot Floyd Carlson hovers number two prototype XV-3 convertiplane during renewal of flight program during which rotors will be tilted in five degree increments until fully tilted in highspeed configuration. Tests were interrupted to do full-scale wind tunnel checks of new two-blade rotor which replaces former three-blade layout.

better but it would present problems too, since it would require tremendous power to force it away from dead center into a supersonic airflow, while it would create aerodynamic forces interfering with control of the aircraft. Solution was a sectionalized cone composed of spring-operated plates which allow Vulcan to move in any direction with a minimum disturbance of airflow and with minimum power.

The turret, designed by the Emerson Electric Manufacturing Co., has undergone static and flight tests at Eglin AFB, Fla.

Britain Weighs Aid For Rotodyne Tests

London—Discussions now proceeding with the Ministry of Supply will decide whether the government is to extend its support of the Fairey Rotodyne to cover flight development costs.

Original contract was for construction of two prototypes and included no provision for flight development. According to a spokesman for the aircraft company, the government intended to review the contract after completion of early flight trials before committing itself to the flight development costs.

The second prototype now is well advanced and should be finished this year. Behavior of the first aircraft in flight trials has proved very satisfactory, the company states.

It is understood that the Ministry is considering paying for some, but not the bulk, of flight development costs. The company would not comment on whether it would be able to proceed with the project on this basis.

But a Fairey spokesman indicated the government is undoubtedly impressed with the world-wide interest shown in both military and civil versions of the aircraft.

Lockheed Acquires Service Installation

Oakland, Calif.—Lockheed Aircraft Service, Inc., has acquired the maintenance and repair facilities of California Eastern Aviation, Inc., here and plans to begin operations this month.

The Oakland installation joins Lockheed facilities already operating at Ontario, Calif., International Airport, New York International Airport and Honolulu Airport, Hawaii. Lockheed Aircraft Service also maintains a technical assistance program with the Japanese government as well as a special devices division at Pomona, Calif.

Facility includes a hangar, two nose docks, warehouse and office space totaling 107,000 sq. ft., and an additional 131,000 sq. ft. of ramp and parking area. Hangar and nose docks will accommodate six four-engine transport-type aircraft simultaneously. Service at the base shops includes engine build-up and teardown, hydraulics, electrical, sheet metal, machine, instrument, radio and upholstery.

The Oakland facility will serve all domestic and international airlines on the West Coast.

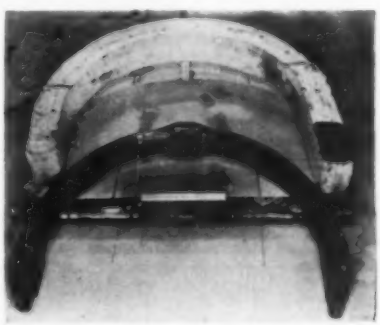
California Eastern Airways, a subsidiary of California Eastern Aviation, will retain its headquarters at Metropolitan Oakland International Airport.

Chemical Bombers' Fuel Use Estimated

A group of 30 chemical bombers would require 105,000 tons of boron fuel a year to keep flying, provided they use the comparatively expensive high energy fuel only about 25% of the time, Donald Gibbons of Arthur D. Little, Inc., estimates.

This amount alone would create an annual market for 150,000 tons of boron oxide, which is equivalent to 45% of current U.S. production. And, Gibbons points out, this does not take into account the development and probable use of solid and liquid boron rocket fuels.

Gibbons made the estimate in a speech to the American Institute of Mining, Metallurgical and Petroleum Engineers in New York.



B-58 Machined Forging

H & B American Machine Co. machined 22 lb. B-58 nacelle frame (front) from 280-lb. forging (AW Feb. 10, p. 48).

Nuclear Warhead Genie Arms F-101B for

Air Defense

First flight photographs of the McDonnell Voodoo F-101B show aircraft armed with the Douglas MB-1 Genie, unguided nuclear air-to-air missile. The Genie is carried externally in the same position as the rotating door which allows smaller missiles to be carried internally. Smaller missiles are rotated into the air stream just prior to launching.

Deflector strips have been placed on the fuselage between the engine air inlets and Genies to keep flow disturbances created by the missiles from interfering with engine operation at high speed. The nose of the Genie probably is lowered just before firing so that its flight path will be a downward arc. This would keep the Genie's exhaust gases from entering the aircraft's engines. The F-101B afterburners appear to be longer than those on the first of its type to fly. This could increase maximum power available at high speed and produce lower temperatures on the aft fuselage.

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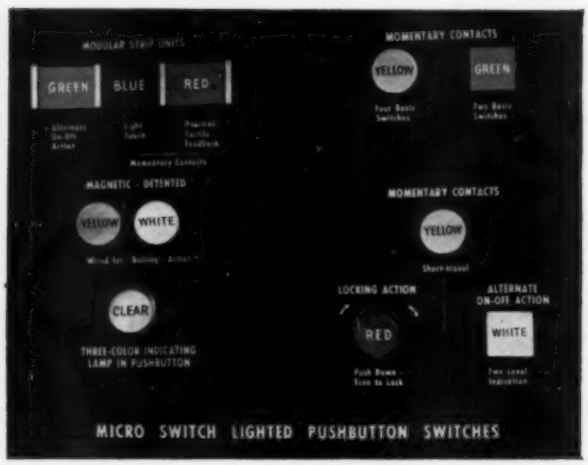
Highly Reliable MICRO for Electronic Computer

Here are six MICRO SWITCH Precision Switches, designed, produced and thoroughly tested for highly reliable performance in electronic computer consoles, aircraft instrument panels and other types of control panels. . . . The series "PB" illuminated pushbutton and the "AS" series of rotary selector switches typify the best in MICRO SWITCH design and the ultimate in MICRO SWITCH performance and reliability.



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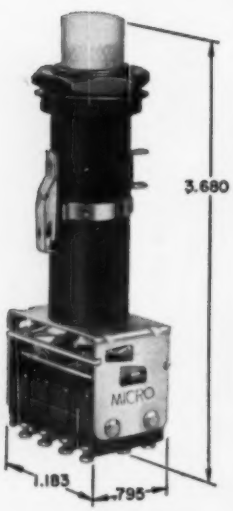
These are the Essentials in Console Design for Today and Tomorrow

Here are two of the many different designs available in Lighted Pushbutton Switches



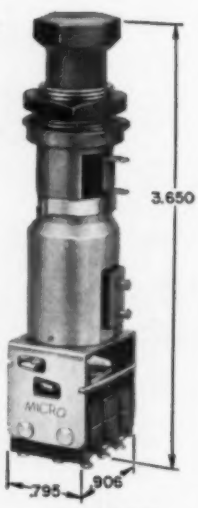
54PB67-T2
with 52PA5 Button

The "50" series switch, shown at left, is a two position, alternate-action switch. The two level visual indication allows extra flexibility in complex control panels. The position of the button—up or down—indicates the condition of the circuit. An independent indicator lamp is free to give additional information, or it can be wired to go "on" and "off" with the switch.

The "50" series switch, at right, is a unique magnetically held push-button. This extremely versatile switch combines multi-circuit switching, indicator light and d-c holding solenoid in one compact unit. When the button is pushed, the switch contacts are held actuated until electrically released. This permits one-by-one "bailing" operation with remote electrical release, allowing complete freedom of panel layout.

These switches are available with two, three or four SPDT contact structures. All lamp and button options may be used. They are rated at 5 amps., 125-250 vac. 3 amps., 30 vdc.

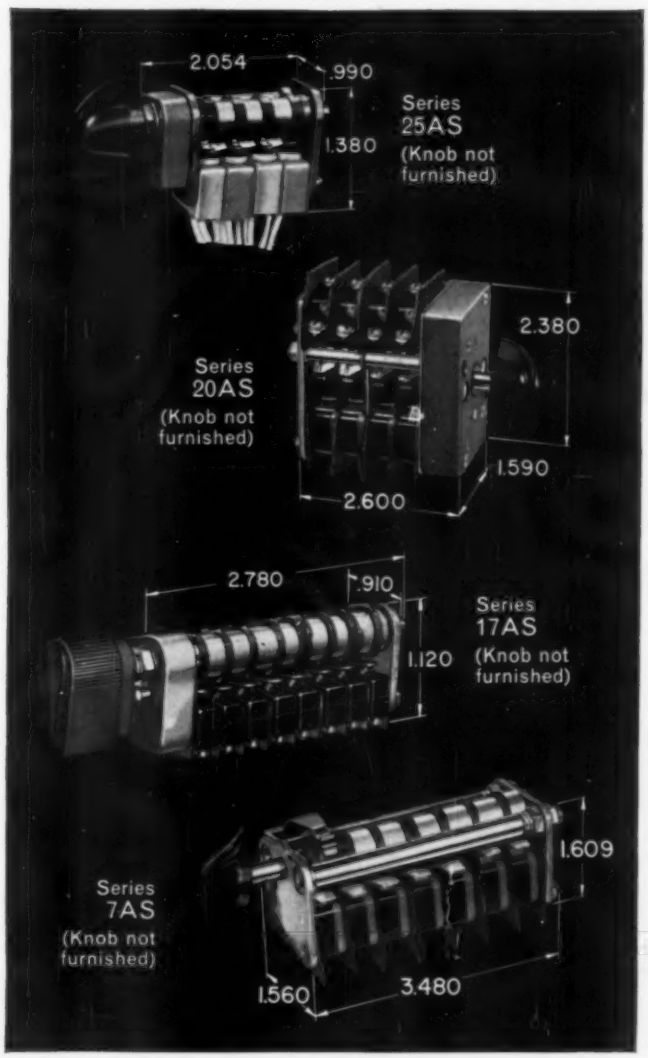
Request Data Sheet No. 133.



53PB8-T2
with 52PA8 Button

Switches have uses unlimited

SWITCH Precision Switches and Aircraft Instrument Panels



Smallest Rotary Selector Switch Assemblies Available . . . Provide up to 20 Switching Units.

"25AS" series rotary selector switch assemblies are the smallest available with environment-proof sealed subminiature basic switching units. Assemblies are available with from two to eight SPDT sealed subminiature switches. Optional positive detent positions from 2 to 8. Rated 5 amps., 125-250 vac. 3 amps., 28 vdc.

"20AS" series rotary selector switch assemblies are extremely versatile. Available with 4 to 20 "V3" type switching units. They are compact, sturdily constructed, and highly reliable. Panel sealing and detent positions are optional. Rated 10 amps., 125-250 vac. 10 amps., 30 vdc.

"17AS" series rotary selector switches are small compact assemblies, available with up to ten SPDT subminiature basic switches. 45 degree angle detents are available in 2 to 8 positions. The use of these assemblies reduces instrument panel space. Rated 5 amps., 125-250 vac. 2½ amps., 30 vdc.

"7AS" series rotary selector switches are compact and sturdy assemblies of two to eight SPDT "V3" type switches, ideal for applications requiring multi-circuit control of 10 amp. circuits. Available in 2 to 8 detent positions. Rated 10 amps., 125-250 vac. 10 amps., 30 vdc.

For complete details on these assemblies ask for Data Sheet 86a.

The two-word name "MICRO SWITCH" is NOT a generic term. It is the name of a division of Minneapolis-Honeywell Regulator Company.

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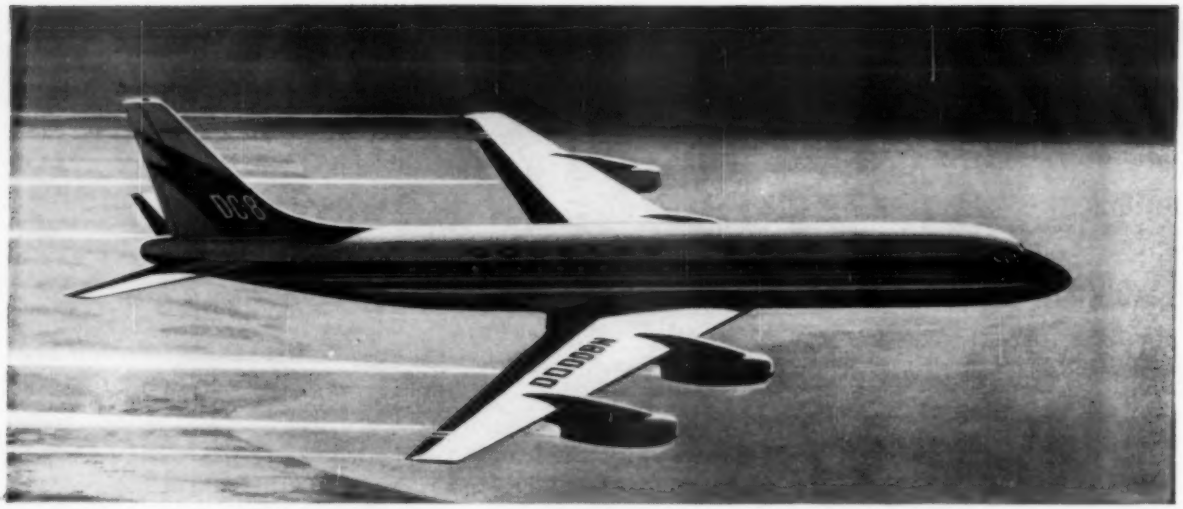

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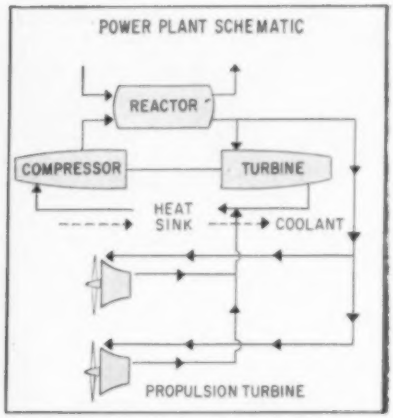

ARTIST'S drawing, left, shows nuclear-powered tanker. Powerplant at right would use helium coolant; reactor would use solid fuel.

Mission Dictates Nuclear Engine Design

By Evert Clark

Washington—Almost every known type of aerial propulsion system can be adapted for nuclear power, but interchangeability of engines from one type of aircraft to another will be severely limited.

Operational problems arising chiefly from the radiation hazard should be balanced out by gains in range and the advantages that result from the range increase—mobility of operation, flexibility of mission and large payloads.

But the limitation that a powerplant developed for a bomber would not be the optimum design for a tanker, cargo, troop-carrying or anti-submarine configuration might be as serious a disadvantage as operational limitations, from the standpoint of rapid development of the art.

Conventional powerplants, particularly in recent years, usually have been developed first for a specific military aircraft. Use then spreads into other military aircraft and on into the commercial market.

Nevertheless, for aircraft where power requirement is high because speed and altitude requirements are high, or because a large payload is necessary, nuclear powerplants have a high potential.

Mission Dictates Design

Weight penalty imposed by radiation shielding and the weight of the reactor itself means that a nuclear aircraft must have a high gross weight. Elimination of the conventional fuel load also means that gross weight remains constant.

Since power requirement and shielding weight and placement vary widely depending on mission, the mission requirement dictates reactor design and, therefore, aircraft design.

To show how mission determines design and to illustrate operational methods, Erwin B. Delson of General Electric Co.'s Aircraft Nuclear Propulsion Department has made a study of possible types of nuclear engines and aircraft and has detailed the probable operational cycle of a tanker powered by nuclear turboprops.

General Electric's Nuclear Propulsion Department is developing a direct air cycle nuclear turbojet under contracts from Air Force and Atomic Energy Commission, and has successfully operated an experimental system in which a turbojet engine was run on heat supplied by a reactor.

Basic difference between nuclear and chemical engines is in the method of supplying heat and the mechanical and cycle variations that result. Heat can be provided directly by heating the propulsion fluid or, indirectly, by transferring heat from a primary fluid to the propulsion fluid. Engines also may be of open or closed cycle, and combinations can be applied to turbojet, turboprop, turbofan, ramjet and rocket engines.

Possible Vehicles

Possible vehicles and missions outlined by Delson:

• **Bomber.** Nuclear weapons payload requirement would be moderate. But high speed and altitude requirements mean high power requirement and, therefore, a heavy powerplant. Divided radiation shield would be used, part of it around the reactor and part protecting the crew. But reactor shielding would be cut to the minimum permitted by considerations of material damage and structural activation. Dose rates higher than peacetime standards might also be accepted. Performance gained by using a divided shield must be balanced against handling and servicing problems, but rearming and turn-around serving might be made automatic.

Lower gross weight could be obtained in a low-altitude, subsonic bomber, or by programming the mission so that much of it was conducted at low reactor powers, permitting less weight in the crew shield.

• **Reconnaissance.** Payload would be moderate, as in the bomber, but probably would require a lower dose rate than nuclear weapons. Local shielding of cameras, etc., might be necessary. Servicing would be more important and time-consuming because of the more complex, reusable payload and would require a heavier reactor shield. Altitude and speed requirements would be similar to a bomber's, again requiring higher power.

• **Cargo or troop carrier.** Payload is large but moderate altitude and speed requirements permit designing the aircraft for maximum payload at minimum power. Cargo can take higher radiation dose than personnel, and some division of shielding might be permissible. For troop-carrying, a unit shield around the reactor is essential. Even then, crew dose rate must be kept considerably lower than in a bomber because this aircraft would operate more frequently and for longer periods. Low external dose rates produce one significant advantage—servicing problems may be no greater than in conventional aircraft.

• **Tanker.** Requirements are similar to those of the cargo plane but, because fuel is the payload, a somewhat higher external dose rate is permissible. Dose rate after shutdown of the reactor would be sufficiently low to permit normal servicing operations, Delson said.

• **Anti-submarine warfare aircraft.** Low speed and altitude requirements permit low power. Payloads will be moder-

for missiles
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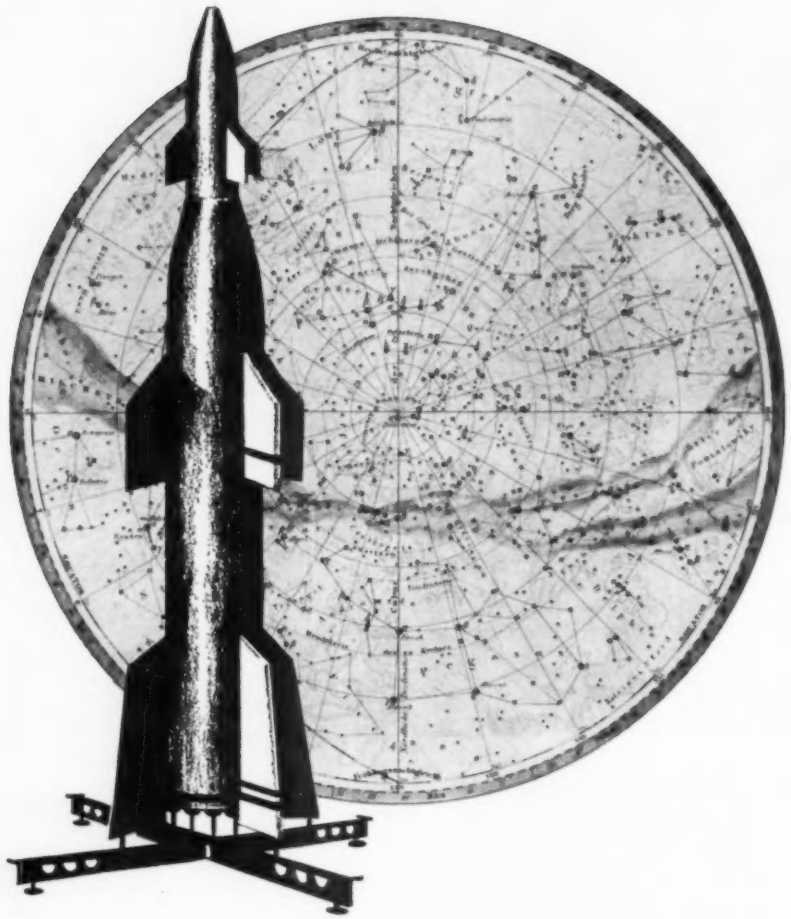

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QUALIFICATION—To maintain this quality through expansion, special quality control systems acceptable to all government approving agencies have been established.

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You can find out about these new advantages in terms of your own needs by calling your nearest Daystrom Transicoil representative. Or, write, wire, or phone current requirements to the plant.

Motors and Motor Generators—Sizes 8, 9, 11, 15, and 18, available for either or both 60 and 400 cycle operation.

Gear Trains—Matched to servo components.

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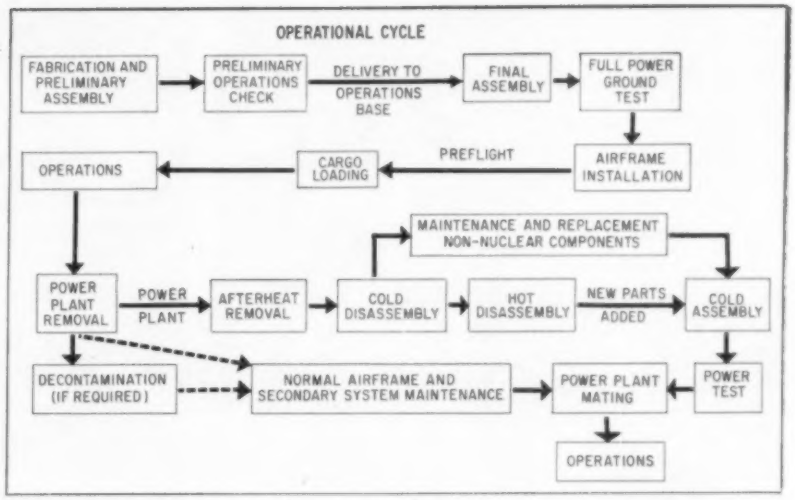
ate. Low dose rate will be necessary because operating personnel and equipment cannot profitably be placed within a crew shield. Aircraft also might require high-speed dash capability for interception, affecting powerplant and shielding.

• **Airborne early warning aircraft.** Modcrate speeds and medium altitudes are required. Extensive equipment and large number of personnel make a unit shield almost mandatory.

• **Missiles.** High-performance system is required, but elimination of personnel permits minimum shielding. Only consideration in shielding is effect of radiation on secondary system components. Since missile has a comparatively short operating life, integrated radiation effect on components is further reduced.



POWERPLANT fabrication and test assembly would occur away from installing site.

Engine Advantages

Both ramjet and rocket engines are applicable for missile use. A basic advantage of nuclear ramjets over the chemical type, Delson said, is that there is no minimum air speed which must be attained for a light-off. "Heat can be provided to the air stream at all velocities and will only be limited by the maximum allowable fuel element temperature," Delson said.

Ramjet requires much higher temperatures than turbines for efficient operation, and prefers higher volume airflow. This means a larger heat source, which would increase the weight penalty if shielding was used.

Rockets require even higher temperatures. Nuclear rocket would still require a propellant but no combustor. Since the propellant need not burn, fluid of optimum low-molecular-weight could be selected. For the same chamber temperatures higher specific impulse may be generated, and fueling problems and the danger of fuel explosions are minimized.

Tanker chosen by Delson to illustrate selection of a powerplant and possible mode of operation would have a large payload and medium speed and altitude requirements.

Powerplant selection emphasizes a basic difference between nuclear and fossile-fuel powered aircraft. Power requirements for a constant gross weight aircraft are at a minimum in the moderate speed range, and increase as airspeed and altitude increase.

Productivity Comparison

A comparison of productivity—defined as payload times velocity, divided by gross weight minus payload—for conventional and nuclear aircraft discloses that:

• **Variation in productivity** versus air speed for variable-weight conventional aircraft indicates that turboprop, turbofan and turbojet powerplant types optimize at increasing air speeds.

• **In a constant gross** weight nuclear aircraft, for an assumed takeoff distance and subsonic flight, relative productivities optimize at approximately the same air speed.

For the maximum productivity desired in the tanker operation, Delson chose a closed-cycle turboprop. Coolant is helium. Reactor uses a solid fuel and solid moderator and is cooled by helium gas, which in turn drives four power turbines.

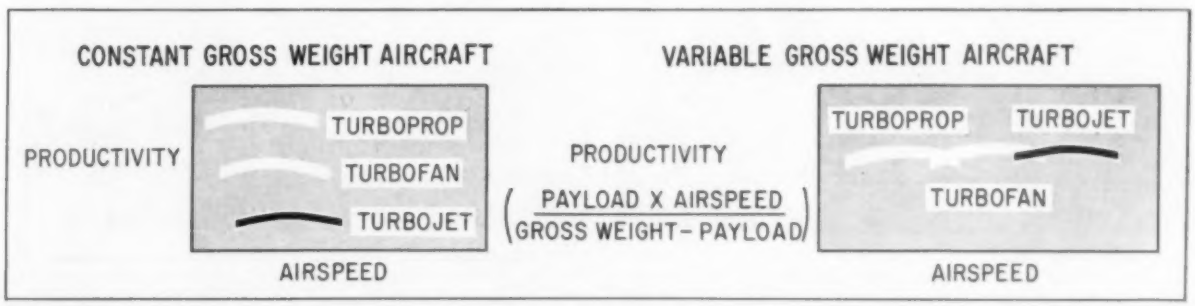
A dual, helium compressor-turbine drive system would be used and also a heat sink for improved efficiency. Heat sink also provides a means for afterheat removal.

Helium flows from the compressor to a reactor inlet plenum, through the reactor, where it is heated to the required temperature, and out to an exit plenum. From here, part of the gas flows to the compressor drive turbine and part to the main power turbines, which drive the propellers. Exhaust gas from all turbines returns to a common line and flows through the heat sink. Cooled gases re-enter the compressor, completing the cycle.

Delson said it is highly probable that effective use could be made of the heat dumped by the turbine-exhaust gases, using air as the cooling fluid. The unit should be designed so that the cooling operation takes place with zero drag addition to the aircraft.

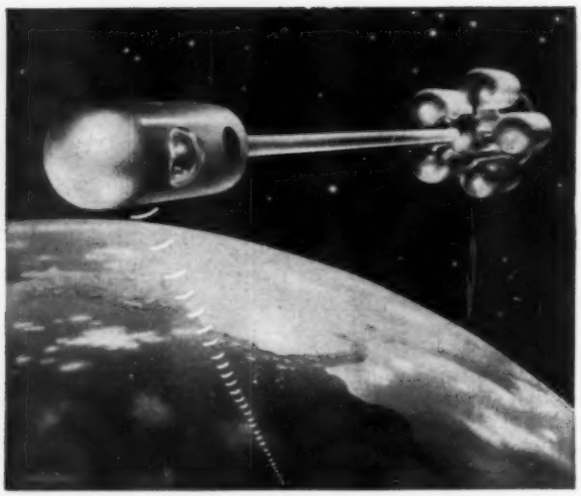
Fabrication and Test

Fabrication and test assembly of the nuclear powerplant probably would occur at some location other than the site of its installation in the aircraft. Reactor would be brought up to a low power to check nuclear operation and control. An alternate heat source might be provided



POWER requirements for constant gross weight aircraft are at minimum in moderate speed range, increase as airspeed and altitude increase.

TEST INSTRUMENTS Bulova's rugged Tachometer Tester for all jet and reciprocating systems meets MIL-T-945A requirements—is accurate to 0.1% with engines on or off. Simple to operate and maintain, this field unit also serves in maintenance depots. Precise Bulova testers include the dual purpose Torqmeter—a dynamometer or calibrated torque source



RECONNAISSANCE SYSTEMS Bulova-developed miniaturized sensor packages, geared to specific tactical missions, feed combat surveillance data to Bulova analysis and display systems. Camera, infra-red, TV and radar techniques, combined and integrated, aid decision-making on land and in space. Satellite applications? Unlimited!

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INFRA-RED COMPONENTS Bulova's advanced IR projects include mosaic cells that will automatically filter out unwanted wave lengths and picture targets clearly against any background. Bulova infra-red R&D covers lead selenide and lead sulfide cells, missile seeker cells, reticles, filters and thermistor bolometers...for defense and industry.

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for testing rotating components.

Powerplant would not be operated on nuclear power, however, because radiation and afterheat problems would make it difficult to ship. For this reason, the powerplant would be shipped disassembled, with fuel elements in separate containers.

At the assembly area, fuel would be installed, complete powerplant would be assembled, system purged and charged with helium, and a full-power ground test made using a semi-remote test stand.

Powerplant would then be radioactive, but the reactor would have sufficient gamma shielding to permit handling with normal radiation precautions, even though the fuel would serve as a neutron shield during flight.

Installation Procedure

Special vehicles and procedures would be required for installing the powerplant in the airframe because of large size and weight, radiation hazard and the necessity for rigid control to avoid damage and place automatic couplings properly. Minor adjustments and some special connections could be made manually since the reactor has a low external shutdown dose.

After installation, the cargo fuel load would be taken aboard and the powerplant brought up to critical and then to lower power. This automatic but relatively slow operation could be done while cargo was being loaded.

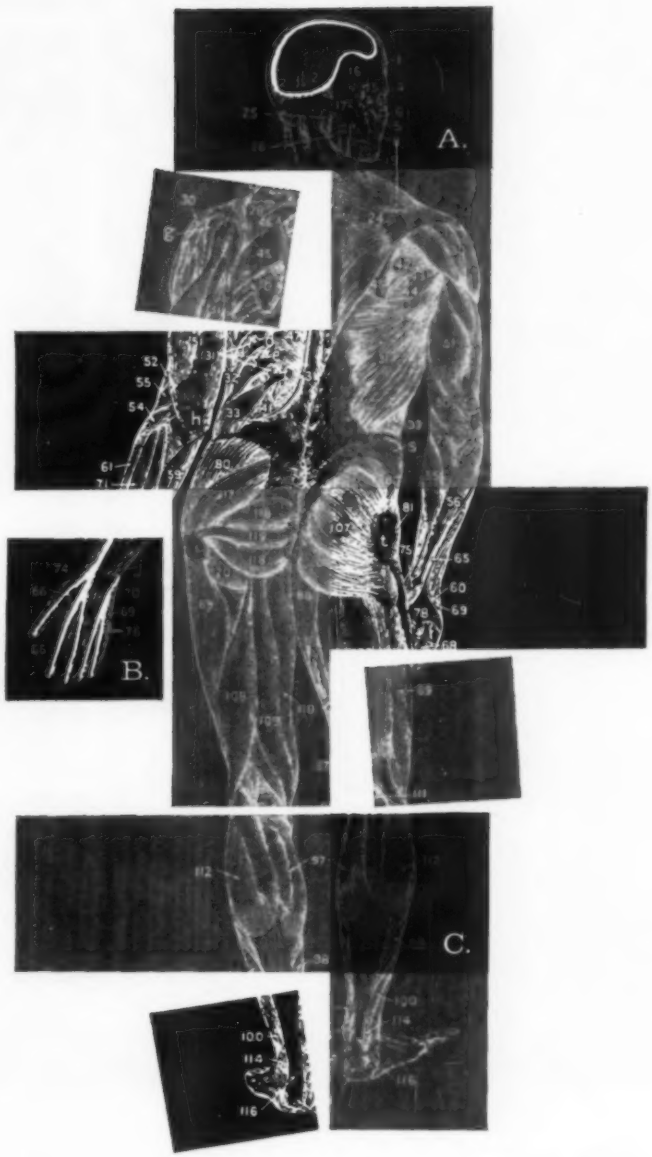
Once the reactor is on the power step, it could be taken to full power rapidly. Aircraft taxis to the takeoff point and takes off after a short preflight run-up. Pilot has the same single power control as in a conventional plane, but the flight engineer's job would be more complex.

Payload of more than 100,000 lb. could be provided by "a reasonable design," Delson said. Range would be limited only by the allowable radiation dose to the crew.

Non-stop delivery of the fuel load to a point half way around the world and return flight could be accomplished without exceeding peacetime radiation dose tolerances, since the aircraft flies out full and returns empty.

When the aircraft lands at its destination, powerplant could be completely shut down and reactor afterheat removal begun. This would be done by providing power to the helium compressors from an external source and an air supply to remove heat from the heat sink. Power and air supplies could be attached manually or automatically at a special ground facility.

Immediately after shutdown, heat to be removed is an appreciable percentage of maximum power, but this decreases quite rapidly. Delson said it probably will be necessary to continue afterheat



achievement in the anatomy of control

Meeting ever higher standards for performance and reliability demands persistent, successful application of new engineering concepts to produce the electronic brains, the nerves, the muscles of control. In this continuing evolution of the hardware of sense, intelligence and reaction, our measure of success is this: Today, United Control equipment, systems and accessories are used by every major aircraft manufacturer for the nation's most advanced missiles, supersonic fighters and bombers, and commercial jetliners.

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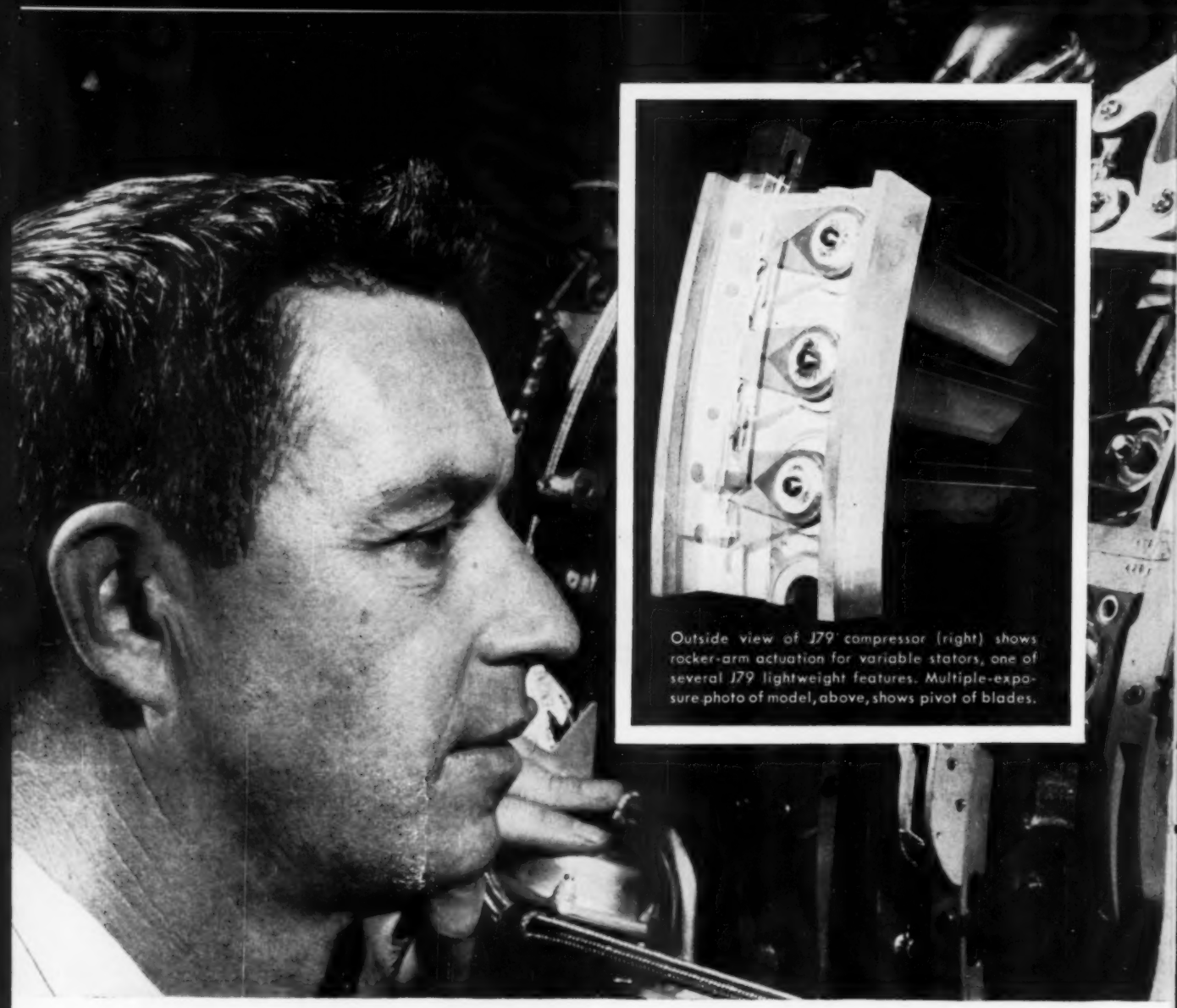
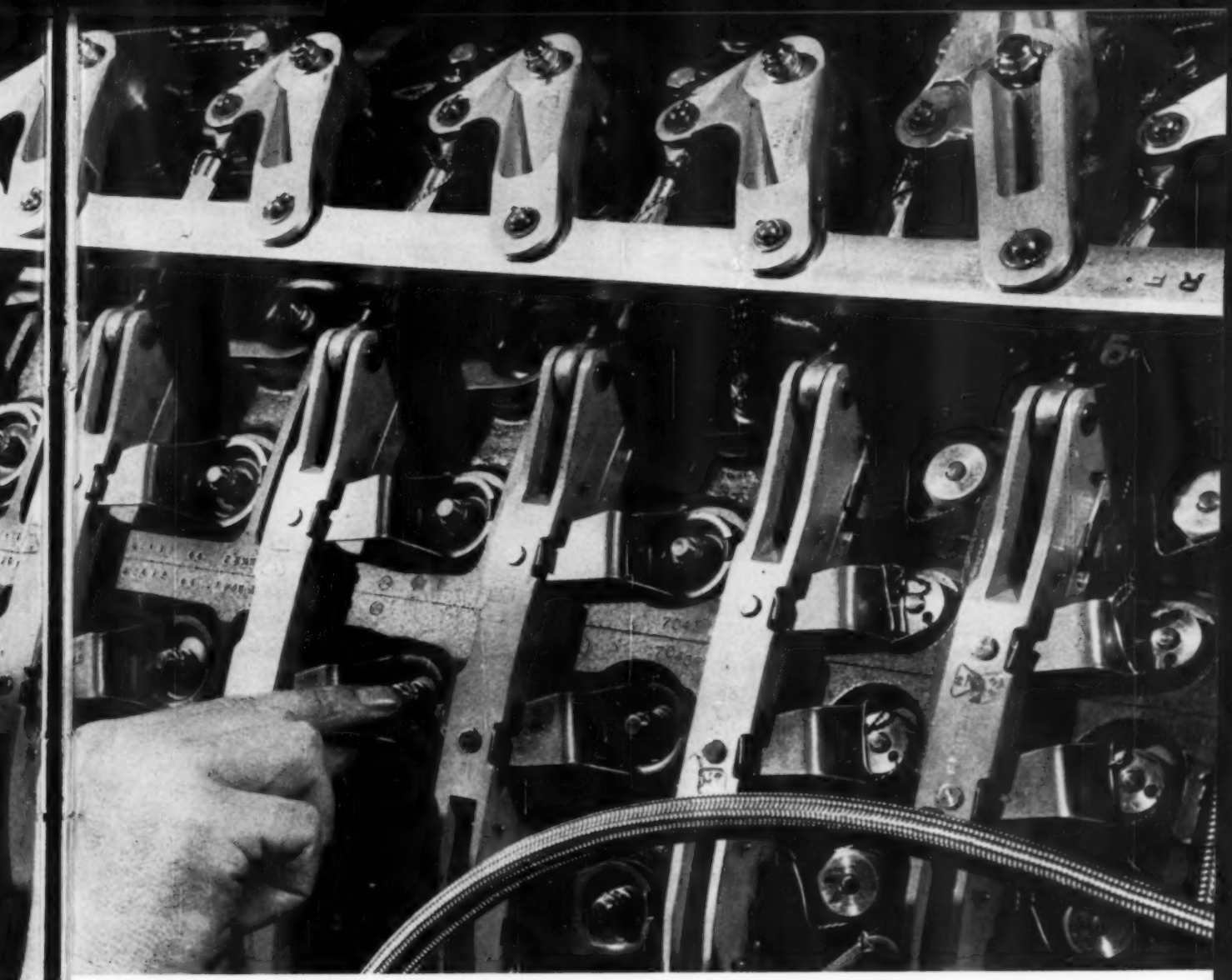


Outside view of J79 compressor (right) shows rocker-arm actuation for variable stators, one of several J79 lightweight features. Multiple-exposure photo of model, above, shows pivot of blades.

GENERAL ELECTRIC'S LIGHTWEIGHT J79 SHOWS...

How An Old Principle Was Adapted To Meet New Aviation Demands



Above, you see one reason why General Electric has been able to answer aviation's need for higher thrust-to-weight ratio turbojets: the variable stator compressor.

Based on an old—and extremely simple—principle, the variable stator compressor matches airflow to engine speed by ***controlling the angle-of-attack of appropriate stator stages*** . . . simplest way to prevent compressor stall and provide the required airflow for efficient sub- and supersonic flight.

In General Electric's J79, the first six compressor stages are variable. This arrangement, added to such lightweight features as a conical turbine shaft, simplified jet nozzle, and others, has produced a turbojet that is . . .

- *Efficient at both sub- and supersonic speeds.*
- *Lightweight and durable.*
- *Easy to maintain.*

Proved in test and in flight, General Electric engines now power America's most advanced aircraft: USAF's Convair B-58, Lockheed F-104A; USN's Chance-Vought Regulus II Missile and Grumman F11F-1F. And right now, still newer General Electric jet engines—all members of G.E.'s lightweight/high-thrust family—are exceeding performance expectations. *General Electric Company, Cincinnati 15, Ohio.* 235-27

G-E LIGHTWEIGHT ENGINES PAY OFF IN SPEED. Powered by General Electric J79, Lockheed F-104A is world's fastest production fighter . . . Convair B-58 is world's fastest bomber.

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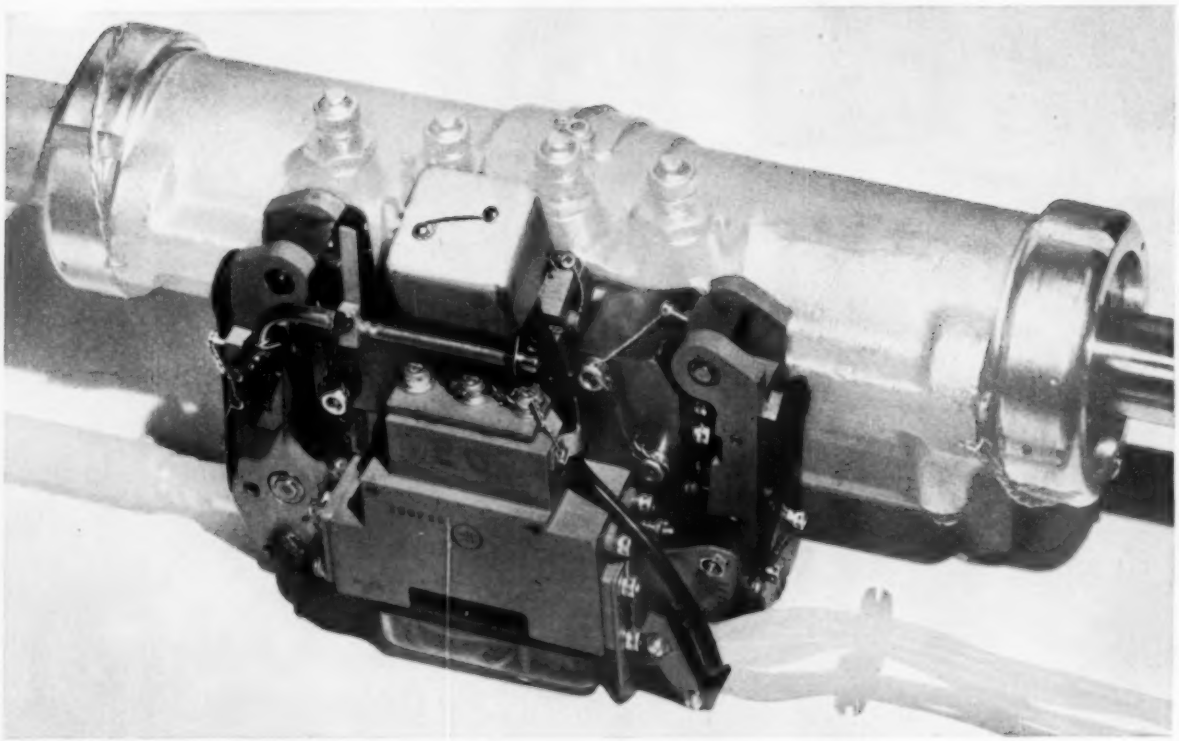
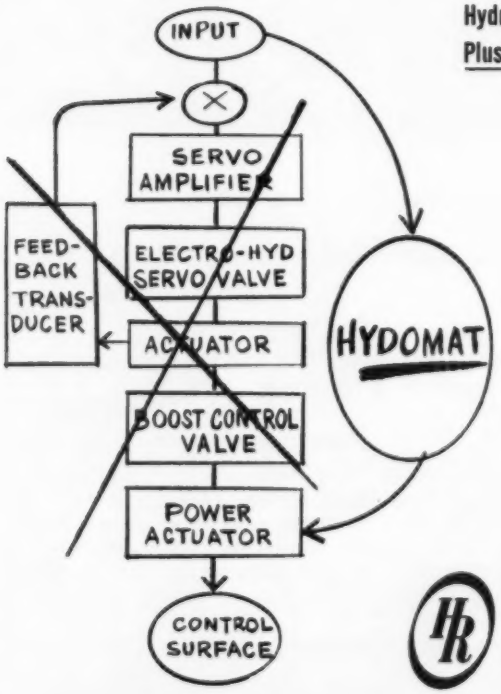


"Hydomat" cuts 27 pounds off Standard Aircraft Control System



Hydraulic Research's System Eliminates 9 lbs. of Components Per Axis, Plus 10-50 lbs. of Plumbing and Structure Without Sacrifice of Function

The Hydomat is a powered flight control servo system of the multiple input type designed for control of a tandem hydraulic cylinder. It will accept mechanical signals created by the pilot, as well as electrical control signals created by electronic amplifiers. Means are provided to remotely select the signal source to obtain the following modes of operation:

1. **Manual:** Mechanical signals operate the valve in the conventional power control manner.
2. **Autopilot:** Electrical signals operate the valve as a conventional electro-hydraulic servo valve.
3. **Damper:** Mechanical signals operate the valve as in the manual mode with superimposed electrical signals to provide damping for improved airframe stability.

For flight safety provision is made for full mechanical override of the electrical signal.

Hydomat modifications are currently in use in missile control systems also.

Write for complete performance data.

HYDRAULIC RESEARCH
AND MANUFACTURING COMPANY
Subsidiary of Bell Aircraft Corp.
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removal all the time the aircraft is on the ground unless there are extremely long time lapses between flights.

After fuel is unloaded, aircraft could return empty, using much lower reactor power, or alternate cargo could be loaded. Alternate cargo would change power requirement and might dictate a modification in shield design.

Normal or emergency maintenance or overhaul would be done at the maintenance base, using the same installation equipment to remove the powerplant. Airframe could be taken to a decontamination station if necessary, and normal airframe and secondary system maintenance cycle follows.

Powerplant again requires afterheat removal from the time of shutdown. Removal fixture and transport dolly should provide the power and air supply required. Powerplant also could be stored until afterheat is sufficiently low that no special provisions are required.

Disassembly

Once afterheat has reached a sufficiently low level, the helium system may be opened and all equipment outside the shield disassembled. With the shield design selected by Delson, most of this could be done manually with proper precautions. Some operations might require extended tools or remote manipulators. Components that are radioactive would be overhauled in special maintenance areas.

Shield assembly would be transported to a fully equipped hot shop, disassembled, and shield broken to permit removal of core, fuel elements and controls. Some reactor control and shield components could be reused.

Normal overhaul cycle would include replacing fuel elements. Fuel might be reprocessed at another facility to reclaim the usable portion.

New and reusable components would be assembled manually, as would the complete power package. It is then stored in a suitable place to await ground power test and installation.

Delson pointed out that a change in any of the basic factors—powerplant types, missions and modes of operation—would cause changes in all the others because of their close interrelationship.

Vertol's Commercial 44 Gets Type Certification

Vertol Aircraft Corp. last week received Civil Aeronautics Administration type certification for its Model 44 commercial helicopter. Production aircraft is certificated at a gross weight of 14,315 lb., compared to 14,000 lb. for the Model 42 prototype. Emergency amphibious gear and automatic pilot equipment developed for the twin-rotor Model 44 is being tested by CAA.

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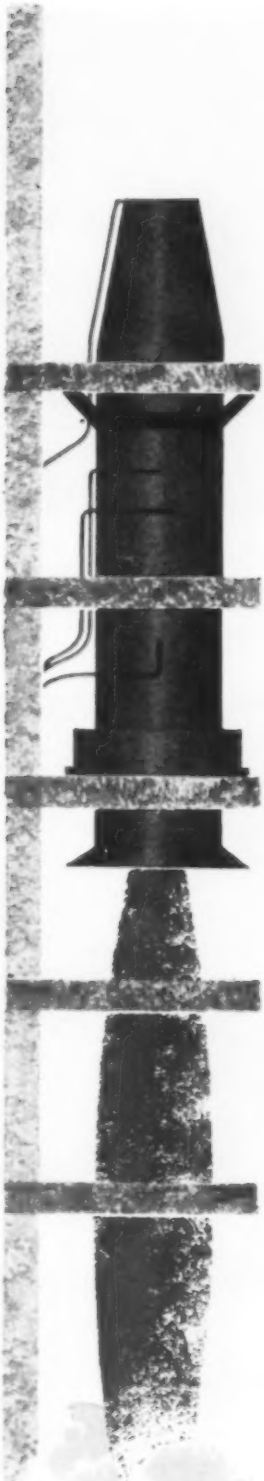
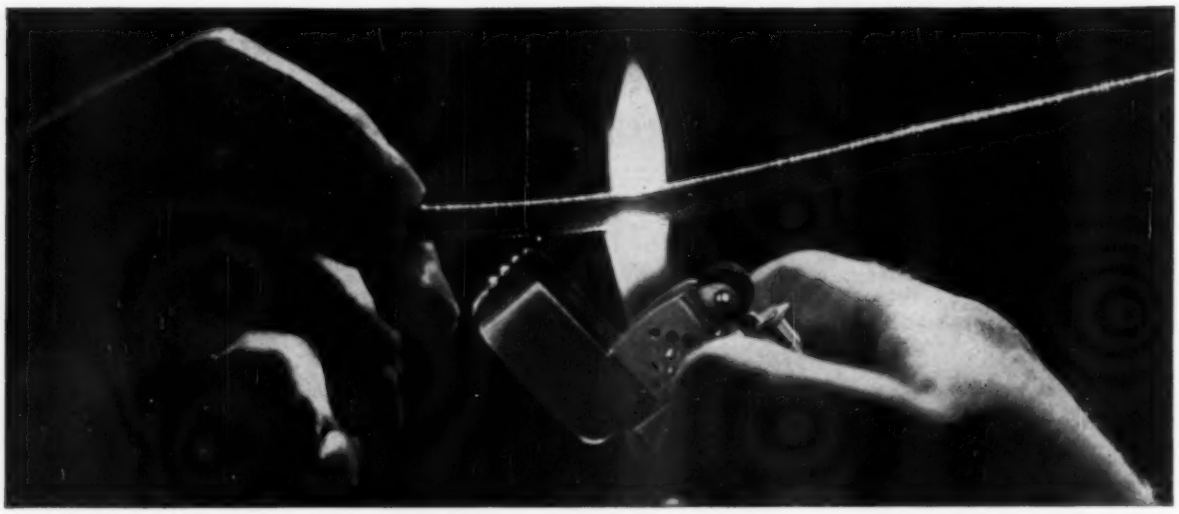
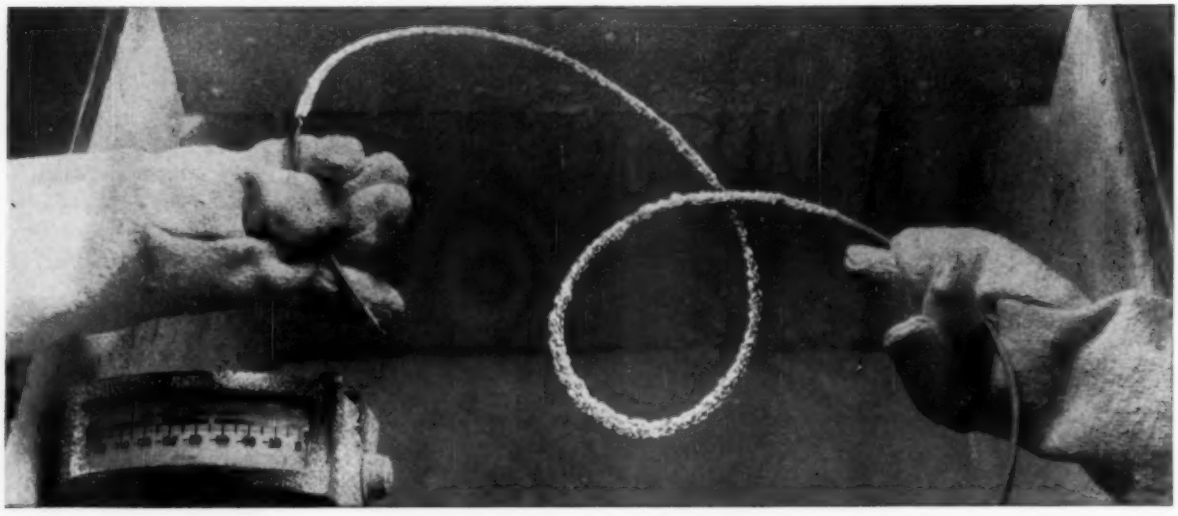




TEST / *Packard Teflon* cable withstands heat at 500° F.*



TEST / *Still flexible at 130° below*

Packard Electric Type PE-400 Extreme Temperature cable exceeds the requirements of military specification MIL-W-7139. It is flexible, compact and functions properly during exposure to extreme temperatures.

Packard Electric also makes many other types of cable with Teflon insulation, all available in colors, single and multiple conductors, and with various jackets and shieldings.

All Packard Teflon cables are permanently sealed against moisture, and offer extremely high resistance to chemicals and abrasion. And they will accept and retain circuit identification printing better than any other Teflon cable. Packard's various Teflon cables are particularly designed for installation in missiles, advanced aircraft, jet engines and electronic applications. Packard Electric maintains branch offices in Detroit, Chicago and Oakland, California, for your convenience.

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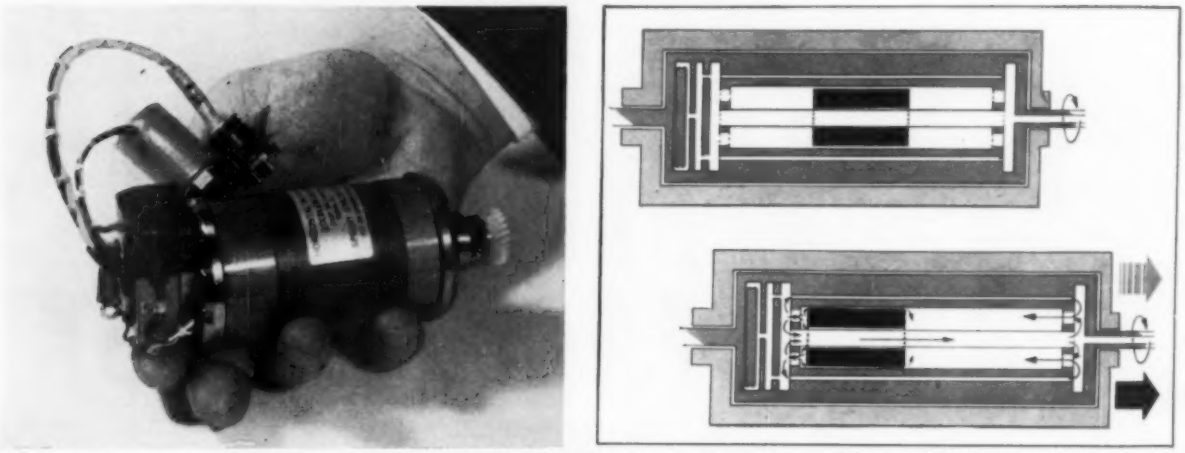


SMALL INTEGRATING ACCELEROMETER, with sensitivity of 10^{-5}Gs, consists of mass-float (black in sketch at right) inside rotating liquid-filled cylinder. Rotating fluid provides low-friction support for mass and its viscosity provides integration.

Accelerometer Has Sensitivity of 10^{-5}Gs

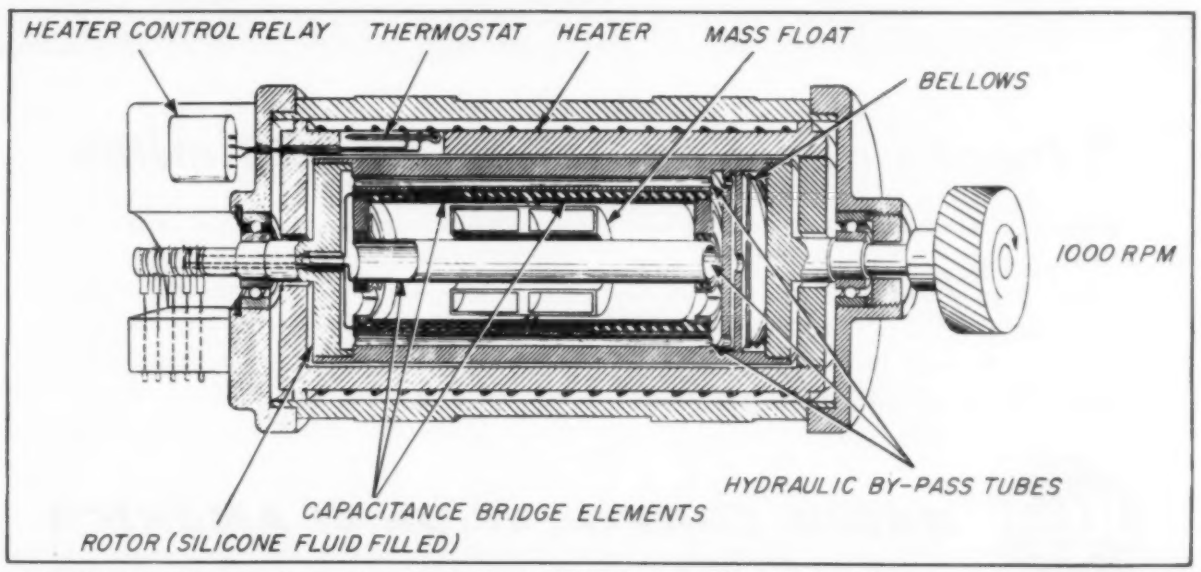
By Philip J. Klass

Great Neck, N. Y.—Integrating accelerometer for inertial navigation systems which is small, lightweight, extremely sensitive and accurate has been developed here by Sperry Gyroscope Co. Device now is in production for two inertial systems which Sperry is building for undisclosed applications.

Threshold sensitivity of new accelerometer is quoted at "better than 10^{-5}Gs." This means, for example, that the device can detect horizontal component of gravity produced by tilting its sensitive axis as little as two seconds of arc away from the true horizontal. This is equivalent to the angle produced by raising one end of a 1½-mi.-long rigid pipe by one inch.

Accuracy of the device is quoted as "within hundredths of 1%" by W. G. Wing, head of Sperry's navigation components engineering department. Present limit on accuracy is set by nonlinearity of the 400 cps. capacitance signal pick-off rather than by the acceleration-sensing mechanism, Wing says.

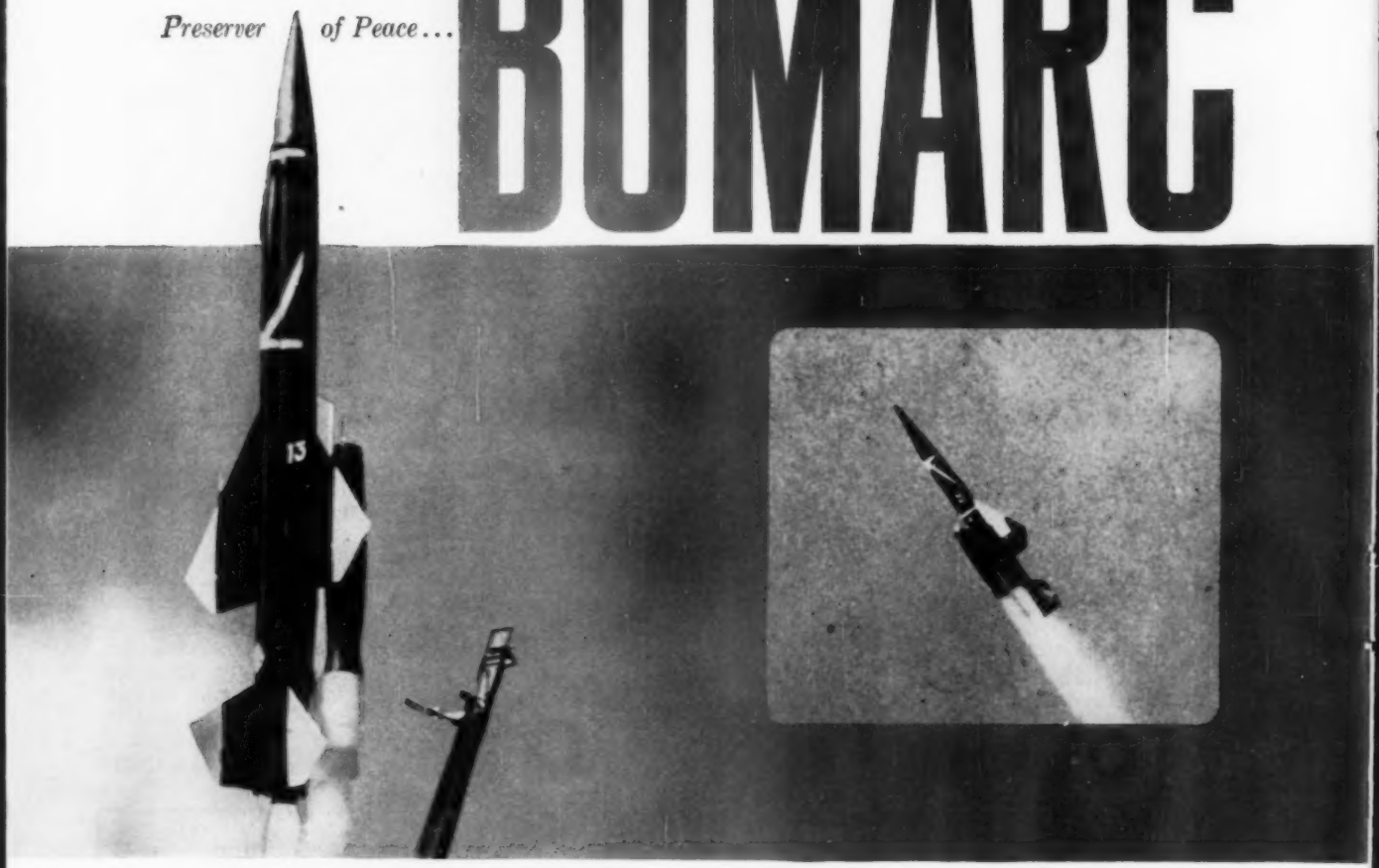
Because device is a linear acceleration sensor, it has far less cross-coupling and zero-shift errors than the widely-used pendulous gyro type accelerometer, according to Wing. Integrating accelerometer weighs only 1¼ lb., not including a small 400 cps. motor used to drive it. Single motor can be used to power two or more accelerometers, as Sperry does in one application, which



CUTAWAY shows details of Sperry integrating accelerometer, including capacitive pick-off which measures mass-float displacement (vehicle velocity), hydraulic bypass ports and thermostatically controlled heater which maintains liquid at constant viscosity.

Preserver of Peace...

BOMARC



Official U.S. Air Force Photo

It tracks down an enemy at 300 miles

Described as the most potent of all ground-to-air defense missiles, the Bomarc pilotless interceptor, designed by Boeing, stands poised for the destruction of any "enemy" bomber within a 200-300 mile range. Its booster rocket has the power to hurl it more than 60,000 feet straight up; then, powered by two ramjet engines, it hurtles by electronic instinct to its target at up to 3 times the speed of sound. For this guardian of our homes and way of life, RCA has been privileged to supply important advance components of the guidance system.

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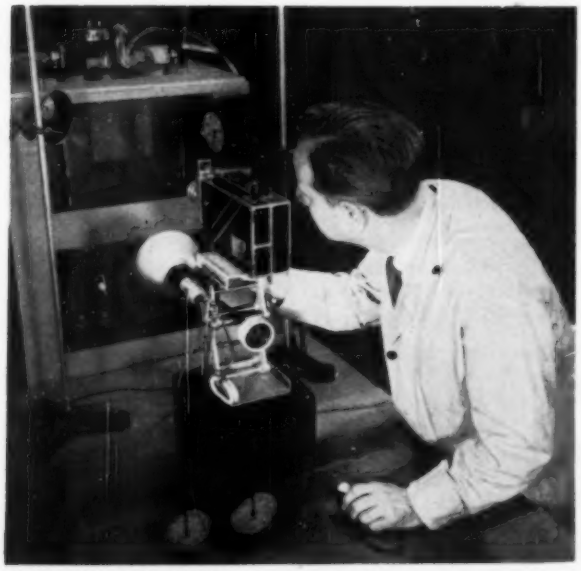

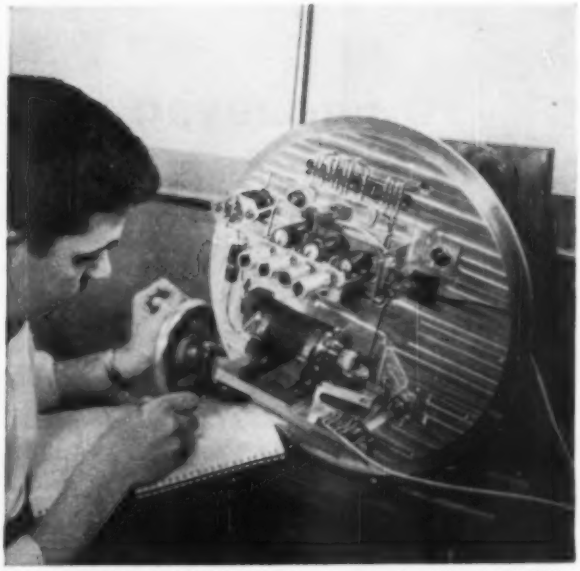

CRITICAL DEPENDENCE of accelerometer accuracy on viscosity of flotation fluid forced Sperry to set up extremely elaborate facilities for measuring viscosity (left). Unit is shown under test (right) on special fixture whose tip-angle is accurately controlled.

explains why motor is not built into the accelerometer itself.

Three metal cylinders form the heart of the Sperry device. The smallest cylinder, called the "mass-float," is the acceleration-sensitive element. It is immersed in silicone fluid inside the next larger cylinder which in turn is supported by bearings within the outer cylinder or shell. Relative densities of the mass-float and silicone fluid are such that the former would rise to the top of the liquid if it were not for the fact that the middle cylinder is driven at 1,000 rpm. by an external motor.

With the middle cylinder rotating at moderately high speed, the silicone fluid inside is caused to rotate and this produces hydrostatic forces which center and support the mass-float within the middle cylinder. Because the mass-float is supported by a rotating (moving) liquid, there is no static friction to be overcome and the slightest acceleration applied to the device along its longitudinal axis will produce a force which moves the mass float along this axis.

Hydraulic Piston Action

As the mass-float moves, it forces silicone liquid from one end of the rotating cylinder through the clearance between the mass-float and cylinder into the opposite end in a sort of hydraulic piston action. The viscous restraint exerted by the silicone fluid results in the mass-float moving at a velocity which is proportional to applied acceleration.

Total displacement of the mass-float therefore is a function of the amplitude of the applied acceleration and the length of time during which it is applied—in other words, the integral of acceleration. Output signal from the capacitance pick-off wound around the rotating cylinder shell, which is a measure of mass-float displacement, is therefore proportional to the integral of acceleration, or velocity.

Error Compensation

In the device as described, any eccentricity of the mass-float outer diameter or rotating cylinder inner diameter, or any taper along their length, would cause non-linearity errors in accelerometer output signal. To minimize this source of error, hydraulic bypass holes are drilled axially through the length of the rotating cylinder shell and the center of the mass-float so that the bulk of liquid flows through these ports when the mass-float is displaced by applied acceleration.

Calibration (proportionality) factor between mass-float displacement and vehicle velocity depends also upon viscosity of the silicone fluid. Latter's viscosity changes about 1% per degree Fahrenheit change in temperature. Sperry uses a thermostatically-controlled heater in the outer shell to maintain silicone temperature within approximately 1F. But by means of undisclosed construction technique, Sperry obtains additional viscosity compensation which results in only a 0.006% change in calibration for the one degree variation.

In order to perform silicone viscosity measurements to the critical accuracy required for the integrating accelerometer, Sperry was forced to set up viscometric measurements facilities which are equaled in the U.S. only by the National Bureau of Standards and two petroleum research laboratories.

Extreme accuracy and sensitivity of the new integrating accelerometer make it particularly well suited for use in inertial systems designed for piloted aircraft or winged missiles where accelerations and acceleration changes are smaller than in ballistic missiles, Wing adds.

Immediate production volume is expected to exceed requirements of Sperry's own inertial systems and the surplus will be available to other inertial system manufacturers.

Firm price has not been set but the accelerometer is expected to sell in the several-thousand-dollar price range.

FILTER CENTER

▶ **Tacan Up in the Air**—Airborne version of Tacan ground station equipment, suitable for installation in a blimp or airplane to provide an airborne navigation reference, will be developed by Navy Bureau of Aeronautics.

▶ **New Intercept Radar**—Westinghouse Air Arm Division is developing long-range airborne interceptor radar under joint Air Force-Navy sponsorship.

▶ **British to Use Solderless Connection**—British are ready to use solderless wire-strap technique, developed several years ago by Bell Telephone Laboratories, in new airborne equipment intended for the Royal Navy. Decision to try wire-wrap technique follows extensive tests by British Ferranti and Radar Research Establishment, under extreme environmental conditions. British also propose to use wire-wrap

"George is great . . . right where he is!"

If ever a compliment could cut the ground out from under a man – you just read it. Just make sure your management never says it about you.

Once upon a time, business moved at a slower pace, and people and things were sort of tidily pigeonholed. So many companies were wedded to a single product, a modest plant, simple processing, comfortable competition, family ownership and one-man rule.

Once upon a time, you could be a specialist in a particular part of a particular business, live within narrow walls, and everything was just dandy. No longer! Today, job isolation is stagnation. Companies, products, industries, have cross-bred like crazy. Anybody's business is everybody's business. Being "an expert" is always essential in depth, lacks much in breadth.

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A report to engineers and scientists from Lockheed Missile Systems— where expanding missile programs insure more promising careers

LOCKHEED ENGINEERS DEVELOPING TRANSISTOR FLIGHT CONTROLS FOR POLARIS

Lockheed engineers are testing and developing transistor flight control systems for the Polaris ballistic missile program. Transistorization of missile control systems has been receiving top attention at Division laboratories in Palo Alto and Sunnyvale. Advantages of transistor designs over present systems include reductions in weight and space requirements.

Flight control activities cover synthesis and analysis of systems; development or procurement of necessary hardware; bench and systems testing of complete control systems; specifications of required flight test programs; and analysis of actual flight tests.

Division scientists and engineers are making many significant contributions that earn Lockheed leadership in missile development. Through their efforts, our Polaris has become the first and only solid fuel strategic ballistic missile program.

As greater emphasis is placed on missiles' role in U.S. defense, our missile projects will continue to grow. This means more career positions are open for qualified engineers and scientists—positions that offer unequalled opportunities for you to move ahead rapidly.

In addition to **Flight Controls,** openings are in: **Electronics, Information Processing, Ground Support, Reliability-Producibility,** as well as **Guidance, Propulsion, Aerodynamics, Thermodynamics, Systems Integration, Human Engineering,** and **Structures.**

Qualified engineers and scientists are invited to write M. W. Peterson, Research and Development Staff, Palo Alto 17, California.

Lockheed **MISSILE SYSTEMS**

A DIVISION OF LOCKHEED AIRCRAFT CORPORATION

SUNNYVALE • PALO ALTO • VAN NUYS • SANTA CRUZ • CALIFORNIA

Gene Schott, Flight Controls Department Manager, right, talks over results of a recent test with design engineer Carlos Avila.

GENERAL ENGINEERING DATA ON NEW

Airborne Modular Design Rotary Actuator

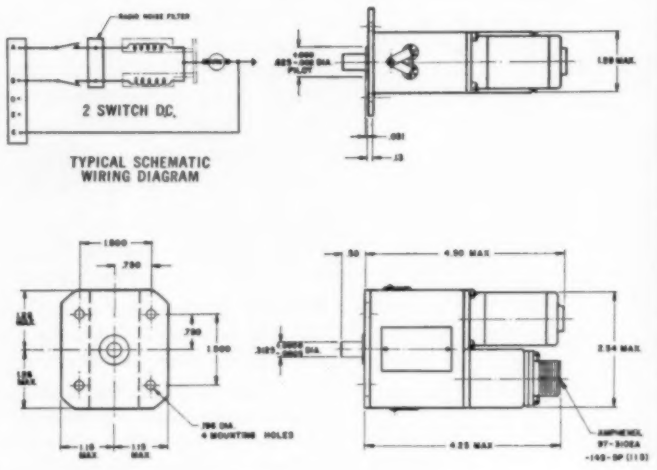
SERIES R12

100 in.-lb. max. op. capacity—26 v d-c or 400 cycles a-c

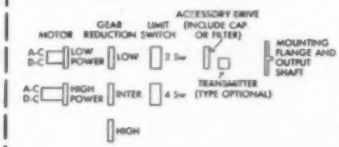
DESCRIPTION:

1. Actuators are designed to meet requirements of MIL-A-8064A and MIL-E-5272A. RD Series—motors are designed to meet requirements of MIL-M-8609 (26 v d-c split field series wound reversible intermittent duty motor with magnetic brake). RA Series—motors are designed to meet requirements of MIL-M-7969 (115v 400 cycles a-c single phase reversible intermittent duty motor with magnetic brake).
2. Actuators include internal starting capacitor or radio noise filter per MIL-I-6181B, limit switches externally adjustable throughout stroke, and non-jamming mechanical stops.
3. Operating strokes from 20° to 270° are available. An additional 10° of overtravel is provided. If intermediate position switches are used, operating strokes of up to 70° either side of intermediate position can be achieved.
4. Maximum operating load—up to 100 in.-lb.* Ultimate static load—up to 200 in.-lb.†
5. Weight—approx. 0.9 lb. for RD Series; 1.1 lb. for RA Series—includes mounting flange and output shaft shown. Weights for special mounting flanges, output shafts, electrical connectors or transmitters will be furnished on receipt of applicable specifications.
6. Electrical connector is shown in standard position, but may be located on other surfaces for special applications.
7. Actuators are available with load limiting devices, intermediate positioning switches, and thermal overload protectors.

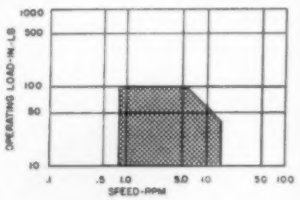
*Depending on motor and gear ratio selected
†Depending on gear ratio selected



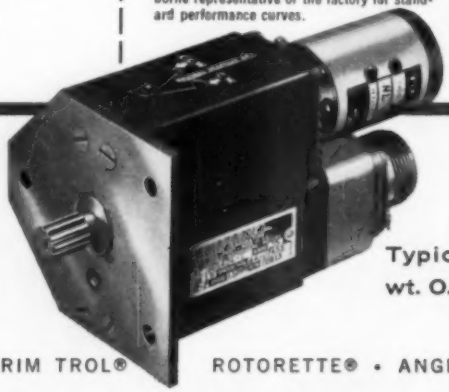
BASIC OPTIONS OF TYPICAL (R12) MODULE



Airborne modular rotary actuator classification R12 is comprised of 12 standardized, interchangeable components from which you can specify over 40 different actuator packages with load ratings, speeds and configurations to meet your requirements. Consult your Airborne representative or the factory for standard performance curves.



Area under curve represents performance range available with standard components. Performances beyond these limits may be achieved by using special components.



Typical RD/RA-12 Module
wt. 0.9—1.1 lb.

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NEW MODULAR ACTUATOR CATALOG 57A

Contains pertinent information on new Airborne modular design rotary and linear actuators, including operating capacity curves and complete dimensional data. Write for a copy today.

technique and short strap wires instead of conventional connectors for interconnecting individual subassemblies. Tools for making wire-wrap connections are made in U. S. by Keller Tool Division, Gardner-Denver Co., Grand Haven, Mich.

► **Missile Tours U. S.**—USAF's Mace missile, successor to the Matador, recently made a 650 mi. flight from New Mexico to Utah guided only by its inertial guidance system. Missile is built by the Martin Co., guidance by AC Spark Plug.

► **"Signed on Dotted Line"**—Major contract awards recently announced by avionics manufacturers include:

• **General Electric Co.** has received a $2.9 million contract from Convair Division of General Dynamics Corp. for electrical power generating systems for use on Convair's 880 jetliner. Each airliner will be equipped with four 40-kva. alternators and constant-speed drives providing a total of 160 kva. of 400 cps. 115/200 volt power.

• **Dage Television Division** of Thompson Products will develop and build transistorized airborne closed-circuit TV equipment under new Lockheed Aircraft Corp. contract. Equipment will be used by Air Force's 1370th Air Photograph and Charting Service, located in West Palm Beach, Fla.

• **Curtiss Wright** has received $1 million order from Air India International for a Boeing 707 flight simulator.

► **Epsco Inc.** reports contract for instrumenting United Aircraft Corp.'s Research Center wind tunnel, to provide equipment for digitizing and recording approximately 20 channels of low-level tunnel measurements. System, which provides extremely high-speed conversion and recording speed, will cost several hundred thousand dollars. Delivery is scheduled for this spring.

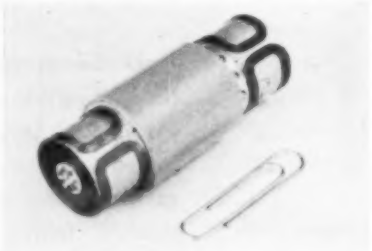
► **Computer Infringement Suit**—Major digital computer manufacturers have been given notice "to cease infringement" under patent No. 2,624,786 by John T. Potter, president of Potter Instrument Co., Plainview, N. Y. Patent, issued in 1953, involves technique used to store and extract information from magnetic core memory elements.

► **Atomic Recorder**—Patent application has been filed for new type of recorder-reproducer which employs modulation of nuclear radiation instead of magnetic field as in conventional tape recorder. Marshall Geller, of Playa del Rey, and Norman Lefcourt of North Hollywood, Calif., who filed for the patent, claim the atomic recorder permits vastly increased frequency range, greater permanency of recordings and allows operation in vicinity of strong magnetic fields.

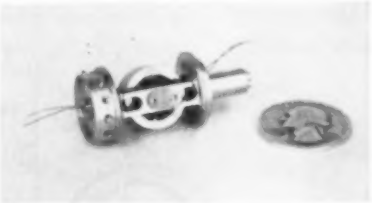
► **What's Ahead**—Defense electronics business will reach $6.4 billion in 1966, almost twice the $3.8 billion figure for 1957, according to recent prediction by Donald G. Mitchell, chairman and president of Sylvania Electric Products Inc. Mitchell's crystal ball indicates defense electronics sales of $4.2 billion in 1958, $5.3 billion in 1961.

Subminiature Gyro

Subminiature floated integrating gyro, weighs only 7 oz., measures 1½ in. dia. x 3 in. long, has angular momentum of 3,000 dyne-centimeter-seconds, range up to 120 deg./sec. and resolution of 0.002 deg./sec. Gyro, developed by Westinghouse Air Arm Division, uses number of techniques which reportedly slash manufacturing cost by 50%.



New Type gyro pick-off and torquer (at opposite ends above) employ d'Arsonval principle to eliminate residual torques normally encountered and to provide linearity of 0.1%. Gyro element is fully floated in temperature controlled fluid, also uses jewel bearings.



Tiny gyro motor, 400 cps., two-phase hysteresis type, operates at 12,000 rpm.; comes up to speed in 4 sec., Westinghouse says. Use of special type steel for motor stator eliminates use of laminations which gives another manufacturing economy.

But the Navy's WV-2 picket planes turn this particular corner of the ocean *every time*. It's Long. 60°15′ E, Lat. 35°47′ N. These long-ranging patrol craft don't need sign posts or markers to stay precisely on assigned routes.

Servo Corporation's DEAD RECKONING TRACER (DRT) — aboard *every* Super Constellation that flies AEW patrol—traces out on a Mercator chart a permanent record of the plane's flight path. The DRT continuously provides a corrected and accurate display of the plane's present position. While this information is being traced out on the chart automatically and simultaneously, the exact figures of longitude and latitude are displayed on the computer counter as well as remote indicators.

Servo Corporation developed the Dead Reckoning Tracer in 1955; it went into service in 1956. The Navy has rated the Servo DRT *"the most accurate automatic system developed anywhere in the world to date."*

Because of the outstanding performance of the patrol DRT installations, Servo Corporation is now developing a smaller, lighter-weight model for fighter planes — under Air Force contract designation AN/APA-110 DRT.

For information on other advanced navigational aids and systems developed by Servo, call or write:

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EASY-TO-HANDLE SPEED With four-wheel power steering, torque converter transmission, four-wheel drive, and "no spin" differentials, the MA-3 maneuvers smoothly and easily at speeds up to 45 miles per hour.

MODULAR DESIGN Major service units are in "modular" packages – can be quickly removed and replaced as complete units to prevent service delays and costly "down time."

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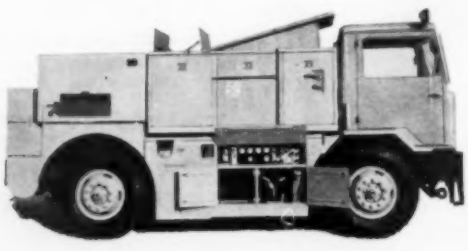

Beechcraft

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Private Pilots Learn IFR Quickly in Test

By Erwin J. Bulban

High degree of instrument flight proficiency can be readily given private pilots in primary training without adding appreciably to total time required for normal course, an experiment concluded recently at West Virginia University indicates.

Experiment was primarily aimed at providing students with sufficient instrument knowledge to enable them to extricate themselves should they encounter unexpected bad weather while flying cross-country rather than make them finished instrument pilots. However, additional instrument time provided two of the initial test group of 10 students quickly brought them to a standard where they could have passed tests for an instrument rating.

Results of the West Virginia University project are important in light of Civil Aeronautics Administration thinking that a definite amount of instrument flight instruction and demonstrated IFR proficiency be required of all classes of pilot certificates in the future, including private pilots. Thought is to spur a sharp decrease in number of fatalities, particularly among private pilots, due to untrained flyers being caught inadvertently in adverse weather.

Weather Accident Factor

According to Civil Aeronautics Administration statistics for 1955, last data available, 93 fatal small-plane accidents resulted from flight into bad weather.

Another factor is that approximately 90% of the light aircraft currently being delivered are fitted with full complements of navigational instruments and radio, making them suitable for IFR operation, yet only a small percentage of their owners have had formal instruction in use of this equipment. Recent Piper survey indicated that although 84% of the Tri-Pacer owners covered in its study owned fully instrumented Super Custom model, only 11% were IFR qualified pilots (AW Mar. 3, p. 252).

This would indicate that there is an enormous potential IFR instruction market now available for flight school operators.

Major Influence

West Virginia University experiment has had a major influence on the draft release out for comment proposing a definite amount of instrument time for private as well as commercial certificates, according to L. Z. Seltzerm, head of the University's Department of Aeronautical Engineering.

Should such a requirement be promulgated, it would have a major effect upon training curriculum used by hundreds of operators providing flight instruction.

In this regard, it is interesting to note that the West Virginia University project was designed so that it could be used by a flight school operator with suitably equipped aircraft, the university states.

A Cessna 140A and a 170A equipped with complete instrument panels and radios were utilized. Attitude and directional gyros were operated by externally mounted venturis. Amber Plexiglas coverings over the windshields and side panels were combined with use of blue-tinted flying goggles to simulate blind flying conditions.

Financial Support

Although cost of the experiment was borne by Link Foundation, associated with Link Aviation, Inc., manufacturer of flight simulators, it was carried out with the understanding that no synthetic trainers would be utilized. Project was closely observed by CAA and

Student	Type Of Instruction	Straight and Level	Turns	Climbs and Descents	Slow Flight and Stalls	Ground Reference Maneuvers	Take-off and Landing	Cross Country	Use of Radio	Total
	Dual VFR	:30	:25	:40	1:21	:36	11:05	4:15	:08	19:00
1	Dual IFR	1:09	1:11	:54	1:03				:18	4:35
	Solo		1:00		1:10	1:56	6:20	10:00		20:26
	Total	1:39	2:36	1:34	3:34	2:32	17:25	14:15	:26	44:01
	Dual VFR	:40	:25	1:05	1:20	1:25	9:35	10:10	:10	24:50
2	Dual IFR	1:00	1:14	:53	:45				:22	4:14
	Solo		1:00		1:30	3:00	5:50	10:00		21:20
	Total	1:40	2:39	1:58	3:35	4:25	15:25	20:10	:32	50:24
	Dual VFR	:55	:55	:40	1:55	:56	11:24	6:15		23:00
3	Dual IFR	1:02	1:22	:56	:59				:22	4:41
	Solo		:40		1:20	2:30	4:10	10:40		19:20
	Total	1:57	2:57	1:36	4:14	3:26	15:34	16:55	:22	47:01
	Dual VFR	:35	:40	:38	1:32	1:30	11:37	5:00	:30	22:02
4	Dual IFR	:45	:50	:38	:30				:16	2:59
	Solo		1:00		2:00	2:20	5:50	10:00		21:10
	Total	1:20	2:30	1:16	4:02	3:50	17:27	15:00	:46	46:11
	Dual VFR	:30	:40	:35	1:21	:54	11:56	5:15		21:11
5	Dual IFR	:46	1:02	:53	1:05				1:10	4:56
	Solo		:40		:40	1:50	6:00	10:20		19:30
	Total	1:16	2:22	1:28	3:06	2:44	17:56	15:35	1:10	45:37
	Dual VFR	:30	1:00	1:05	1:15	1:30	9:25	5:55	1:35	22:15
6	Dual IFR	:25	1:00	1:15	1:55			:20	:50	5:45
	Solo		1:10		:55	2:35	5:40	11:00		21:20
	Total	:55	3:10	2:20	4:05	4:05	15:05	17:15	2:25	49:20
	Dual VFR	:15	1:00	:50	1:15	1:30	12:45	6:35	:40	24:50
7	Dual IFR	:35	1:05	1:10	1:15					4:05
	Solo		:15	:10	1:50	1:40	6:05	10:00		20:00
	Total	:50	2:20	2:10	4:20	3:10	18:50	16:35	:40	48:55
	Dual VFR	:30	1:40	1:00	1:40	2:30	13:10	4:55	1:35	27:00
8	Dual IFR	:50	1:15	:55	1:10					4:10
	Solo		:10	:10	1:15	1:30	5:55	10:00	:15	19:15
	Total	1:20	3:05	2:05	4:05	4:00	19:05	14:55	1:50	50:25
	Dual VFR	:25	1:40	:45	1:35	1:40	14:15	9:25	:55	30:40
9	Dual IFR	:25	1:00	1:20	1:25			:20		4:30
	Solo		:10	:20	1:50	2:40	4:45	10:20		20:05
	Total	:50	2:50	2:25	4:50	4:20	19:00	20:05	:55	55:15
	Dual VFR	:20	1:25	1:10	1:20	1:50	8:50	4:45	:40	20:20
10	Dual IFR	:55	1:10	1:00	1:20			:30	:20	5:15
	Solo		:10	:10	1:20	:55	6:05	10:00		18:40
	Total	1:15	2:45	2:20	4:00	2:45	14:55	15:15	1:00	44:15

TIME DISTRIBUTION, primary flight phase, of experimental contact-instrument project.

CAB representatives, with students checked by representatives of the former agency.

Ten students, picked from the university's enrollment and screened to ensure that they had no previous flight training experience, ranged in age from 18 to 26. Students were required to complete the private pilot's course during a single semester of 16 weeks and had to maintain their complete academic schedule, requiring flying on some days not entirely suited for instruction. These factors combined were responsible for some students requiring more dual instruction time than would have been normally necessary, the university feels.

Instrument training began with the first lesson and each of the dual instruction periods of pre-solo phase were divided equally between contact and IFR training. At the end of the primary flight program, two students were selected to take an additional 20 hr. of IFR instruction, this advanced phase including instrument procedures and radio navigation.

Students were compared at the end of their first phases with flight students who had completed a conventional private pilot course; the two students taking additional instrument training were compared with applicants for instrument ratings who met requirements of CAR Part 20, paragraphs 20.44, 20.127 and 20.128.

Flight instructors assigned to the experimental project held both commercial and instructor ratings but only one flight instructor also had an instrument rating.

Each was assigned five students. During the experiment there was no apparent difference in the instrument proficiency of students assigned to either instructor.

University feels that this may be due to the fact that radio orientation procedures, instrument approaches and holding patterns were not included in the primary training phase, indicating that for this portion of contact-instrument training, instructor does not have to be a finished instrument pilot.

All 10 students passed the CAA examination for private pilot certificate; maximum time required of any student was 55 hr., 15 min., with one student passing after 44 hr. 1 min. instruction. Amount of time devoted to instrument flight instruction varied from 5 hr. 45 min. to a minimum of 2 hr. 59 min. Total time was counted from time throttle was opened until engine was stopped and included an average of 4 hr. 41 min. of taxiing time.

Comments from observers of the program agreed that the experimental-group students would have a much better chance of extricating themselves from adverse weather conditions than the average private pilot, trainees being far more cognizant of instruments during contact flight and placing much more trust in their compass on cross-country flights. Observers emphasized that training, in the primary phase of the contact-instrument project, did not equip students to make planned IFR flights.

CAA Examiners' Report

The CAA examiners who checked the two students who had taken additional instrument training reported that one student was fully up to the standard of instrument rating; the other student, with a few more hours of practice at altitude control and tak-

	Student No. 5	Student No. 10
Straight and Level, Medium Turns	:40	:30
Stalls	:30	:30
Recovery from Unusual Attitudes	:10	:30
Timed Turns and Turns to Headings	1:05	:50
Airway Traffic Control Procedures	1:10	1:15
Radio Orientations	5:00	5:05
Std. Inst. Approach Procedure and Missed Approach (VOR)	1:50	1:45
Std. Inst. Approach Procedure and Missed Approach (L/MF)	2:15	2:00
Holding Patterns	1:42	1:42
Approach Control	:42	1:21
Simulated GCA Advisory	:20	:30
Simulated Inst. Cross Country with Three Airport Approaches	4:15	4:15
Instrument Emergency Procedures	:25	:15
Total Time	**20:04**	**20:28**

FLIGHT SCHEDULE provided two students who took additional instrument training.

Progress in Propulsion at Marquardt

by
Roy E. Marquardt, President

In all of the complex of modern weaponry no area affords more challenge than the field of supersonic and hypersonic propulsion. Here, where the stringent requirements for engine weight, size and thrust are creating problems of critical consequence, Marquardt engineers and scientists are making continuous progress.

The supersonic ramjets now being produced at our new Ogden, Utah, manufacturing facility provide the flight power for the Boeing Bomarc interceptor missile. Under John Winter, our chief engineer in powerplants, Marquardt engineers spent many thousand engineering manhours, to make this engine the fastest and most efficient air breathing engine in our defense arsenal.

Two Marquardt ramjet engines sustain the flight of the Bomarc after it is launched vertically into the air. The ramjets provide a range that allows the weapon to destroy enemy bombers at a far greater distance than any other missile presently in use in air defense.

The Bomarc application is only one of the many propulsion projects now underway at Marquardt. Currently under development are several advanced supersonic ramjet engines for application on future weapon systems.

Other activities are advancing man's knowledge of hypersonic propulsion, special high energy fuels, and Aircraft Nuclear Propulsion.

Engineers and scientists with a vision for the future are invited to investigate the opportunities at Marquardt. Address your inquiries to Jim Dale, Professional Personnel, 16551 Saticoy Street, Van Nuys, California.

Roy E Marquardt

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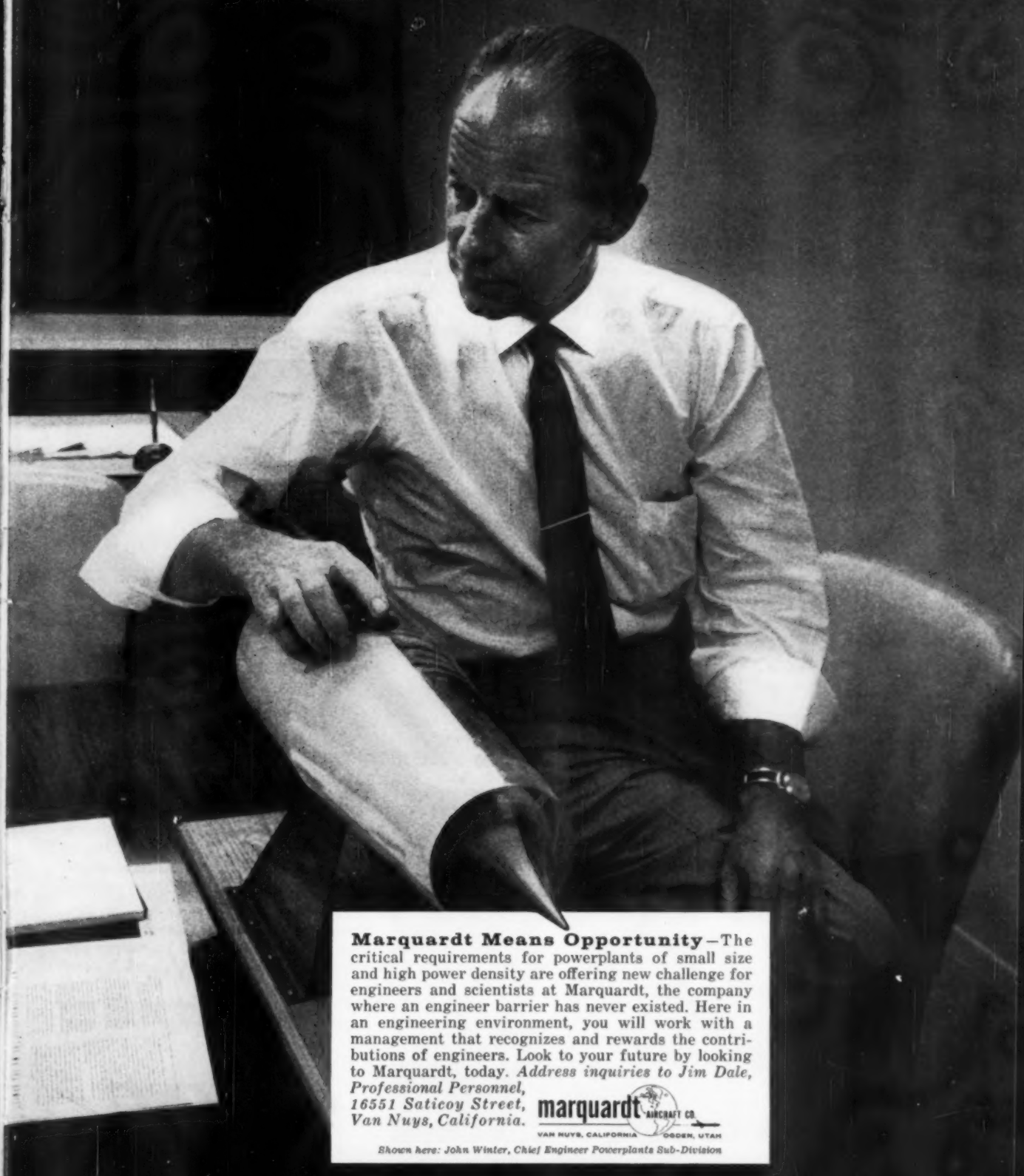
To Powerplant Engineers Facing an ENGINEER | BARRIER *



Marquardt Means Opportunity—The critical requirements for powerplants of small size and high power density are offering new challenge for engineers and scientists at Marquardt, the company where an engineer barrier has never existed. Here in an engineering environment, you will work with a management that recognizes and rewards the contributions of engineers. Look to your future by looking to Marquardt, today. *Address inquiries to Jim Dale, Professional Personnel, 16551 Saticoy Street, Van Nuys, California.*

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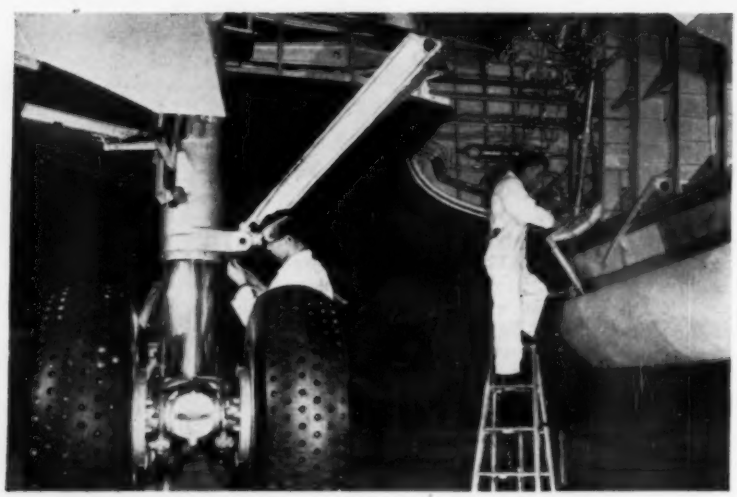
Shown here: John Winter, Chief Engineer Powerplants Sub-Division

* ENGINEER | BARRIER—an achievement level beyond which you cannot advance

REPORT ON MAINTENANCE

EASE OF MAINTENANCE for minimum ground time is designed into the Boeing 707 and its shorter-range 720 sister ship. Hinged panels and hatches give ready access to control runs, wire bundles, hydraulic lines, etc.

POD-MOUNTING OF ENGINES, a Boeing development, provides quick, convenient, ground-level accessibility, and permits rapid engine changes. Top-hinged cowlings, easily raised by one man, expose full length of engine.



THE BOEING 707 AND 720 are designed for fast ramp servicing. Complete fueling requires only 11 to 15 minutes. Although they will carry twice the passengers, Boeing jetliners will require no more time at airport loading gates than large present-day airliners.

WHEEL WELL INSTALLATIONS of hydraulic lines, controls and accessories provide immediate maintenance access. In every area, Boeing 707 and 720 jetliners will bring airlines all the operating benefits of Boeing's unparalleled multi-jet aircraft experience.

BOEING
Family of jet airliners

These airlines already have ordered models of the Boeing family of jetliners:

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ing more precise "bites" at track interceptions, would have met IFR standards.

No consideration was given in either examination of the students lack of experience, normal IFR grading standards being used. Examiners reported that they felt the students turned in a better performance than many actual IFR applicants.

Observers felt that key to success of the experiment was incorporating instrument training into the beginning of flight training; providing a psychological tendency on the part of the student to accept the instruments as a part of the airplane rather than a separate adjunct. Checks revealed that students performed maneuvers, including slow flight, stalls, stall recoveries and turns far more proficiently on instruments than when using visual reference and actually preferred doing the maneuvers using their instruments. High-level of contact flight technique was found due to the students' ability to read instruments and correct mistakes that would not have been noticed in "seat-of-the-pants" flying.

West Virginia University, Morgantown, has collated results of the contact-instrument flight training experiment in Bulletin Series 58 No. 7-5.

Civil Agencies to Use 278 Aircraft in Year

U. S. government civil agencies will operate 278 airplanes, including 36 new airplanes, in Fiscal 1959. Operating budget for the planes, ranging from multi-engine transports to helicopters and lightplanes, will total $9,153,691.

Civil Aeronautics Administration is largest fleet operator, with 112 airplanes; next comes Fish & Wild Life Service of Department of Interior with 52 aircraft used in enforcing fish and game laws. Department of Agriculture will operate 42 aircraft, including eight new airplanes to be purchased. Immigration and Naturalization Service will employ 27 planes, mainly in border patrol.

Civil Aeronautics Board will use a single aircraft to carry accident investigation parties.

Reds Push Research On Flap Wing Craft

Motor-powered and muscle-powered models of ornithopter aircraft designs are being seriously studied by Soviet Flapping Wing Committee of DOSAAF (Voluntary Society for Corporation with the Army, Air Force and Navy).

Former type are called "flying motorcycles," the latter "flying bicycles." Some 13 different versions of ornithopter craft have been developed recently, one of the flying motorcycle designs carrying one man with the wings and powerplant strapped to his back. Other versions contemplate carrying several people in streamlined fuselages with retractable landing gear.

Committee reports some results of its early work—it marks its 10th Anniversary this year—notably the Kashuk flapping wing glider exhibited several years ago during a Moscow air parade. Kashuk's wings flexed as air currents actuated pneumatic springs to extend the glider's flight.

USAF Plans Sale Of 350 Aircraft

Some 350 surplus bombers, trainers and cargo planes will be disposed of by USAF through competitive and site bids in the next few months.

On Apr. 10 USAF will dispose of 231 planes through written bids. Available will be 11 North American B-25s, 32 North American T-6Gs, 150 Douglas B-26s, 10 Curtiss C-46s, 27 North American T-28s and one Bell H-13G helicopter, the latter without engine.

Surplus sale planned for May has been moved up to June 11. On disposal list are 20 T-6Gs, 30 T-28s, 10 C-46s, 30 Beech C-45Gs, 15 B-26s and 15 B-25s.

Prior announcements had stated that L-17 Navion, Sikorsky H-5, Vertol H-21 and North American F-51s would be included in the latter offering, but these have been withdrawn due to planes being taken by other government agencies or because of prior sales at other Air Force activities.

Planes are all located at Arizona Aircraft Storage Branch, Davis-Monthan AFB, Tucson.

Details can be obtained by contacting Hugh Polando at the storage center.

Northern Aircraft To Build Amphibian

Alexandria, Minn.—Northern Aircraft, Inc., of Alexandria has acquired manufacturing rights for Republic Aviation Corp.'s amphibious Seabee.

Company, which now produces Bellanca Cruisemaster, said it will build an improved Seabee version, based on results of engineering and design studies carried out in past two years.

Seabee parts will be manufactured at Alexandria. Firm said it plans to expand facilities and will also increase Cruisemaster production. Northern has turned out 55 Cruisemasters since company was founded two years ago.

Move to acquire Seabee rights followed purchase of majority interest in Northern by J. K. Downer, Saginaw, Mich., chairman of the board. Roy L. Strong, company founder, will continue as president and general manager.

Italians Test Four-Seat Helicopter

Certification trials are being made by new four-place Lualdi L.55 helicopter which will employ considerable reinforced plastics construction in its production form to cut final purchase cost. Powered by a 180-hp. Lycoming, L.55 is designed for cruise speed of 80 mph. at 75% power, 984-fpm. rate of climb, endurance of three hours and hovering ceiling, in ground effect, of 9,186 ft. Weight empty is 1,321 lb., gross weight is 2,202 lb. Two-blade main rotor has 32.8-ft. diameter, overall length of helicopter with blade aligned with fuselage is 39 ft., height is 9.5 ft. Rotor system incorporates certain features of Hiller helicopters, for which Lualdi has production license in Italy.

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Certification Given For Executive PV-2

Supplemental type certificate for conversion of surplus Lockheed PV-2 Ventura patrol bombers to executive transports has been granted Oakland Airmotive Co., Calif., which is completing first airplane, designated Centaurus.

Centaurus will cruise at 280 mph. at 10,000 ft. at 55% power of its Pratt & Whitney R2800 engines and will have a range of more than 2,000 mi., according to Oakland Airmotive President Edwin H. Gough. Gross weight is 32,000 lb. and useful load is 13,000 lb. Seating can be fitted for eight to 14 passengers; the number one Oakland Airmotive conversion has 11 seats. Price is "less than $200,000."

Modification program includes recontouring the fuselage to provide cleaner lines, installation of new flaps with "bat wings" deleted; modified, squared-off wingtips and redesigned ailerons, large propeller spinners, relocated exhaust collect rings with short stacks, picture windows, revised nose.

Oakland Airmotive has been developing the PV-2 conversion for two years at the International Airport. In the company's nine-year life it has handled approximately 100 executive aircraft conversions.

PRIVATE LINES

Rawdon Bros. Aircraft, Wichita, Kan., has stepped up production of its T-1 low-wing agricultural airplane, which is now available with either 150-hp. or 180-hp. Lycoming engine. Agricultural Engineering Division of Department of Agriculture, Forest Grove, Ore., recently took delivery of a T-1.

Twin-engine four-place Czech Super Aero is reported being exported to more than 20 countries, with Russian trade officials giving program heavy support due to lack of similar Soviet-built type.

Bay Aviation Services Co., San Francisco International executive plane terminal operator, is handling fueling of Japan Air Lines transports. Bay Aviation provides similar services for Qantas, BOAC and Slick.

AiResearch Aviation Service Division has put customized AiResearch GTP 70-17 gas turbine auxiliary power unit and RCA AVQ-10 weather radar in second of Civil Aeronautics Administration Convair 440s used in checking navigation and communications facilities.

New Grumman Gulfstream turboprop-powered executive transport will undergo initial flight test program at company's Stuart, Fla., air terminal facilities.

Site is used because of high percentage of favorable flying weather compared to New York area.

Soviet Aviation industry is lagging in development and production of new light civil airplanes in 1,100 lb.-4,400-lb. gross weight category, Russian paper Red Star reports.

Tenth Annual Safety and Efficiency Clinic for owners of Beech airplanes started Mar. 3. Owners in each distributor's area will be notified when factory teams will be on hand to perform free maintenance inspections of their aircraft. Check will cover more than 100 major items. Last year 1,527 Beech planes were checked during the tour.

Midland Aero Corp., Midland Air Terminal, Tex., and Minnesota Airmotive, Inc., Wold-Chamberlain Field, Minneapolis, are new Aero Design & Engineering Corp. distributors.

Free flight test is scheduled soon for Monte-Copter pressure helicopter, which made first tethered flight at Boeing Field, Seattle, Wash., late last month. Craft has two Continental engines delivering 160 air hp. each; installation of a single 200 air hp. powerplant is planned in later model.

ELECTRIC-POWERED rotor blade test rig delivers constant horsepower to helicopter rotor.

Electric Test Rig Curbs Vibration

Bloomfield, Conn.—Helicopter rotor blades up to 90 ft. in diameter can be tested on a new 1,300 hp. electrically operated rig being put into operation here by Kaman Aircraft Corp.

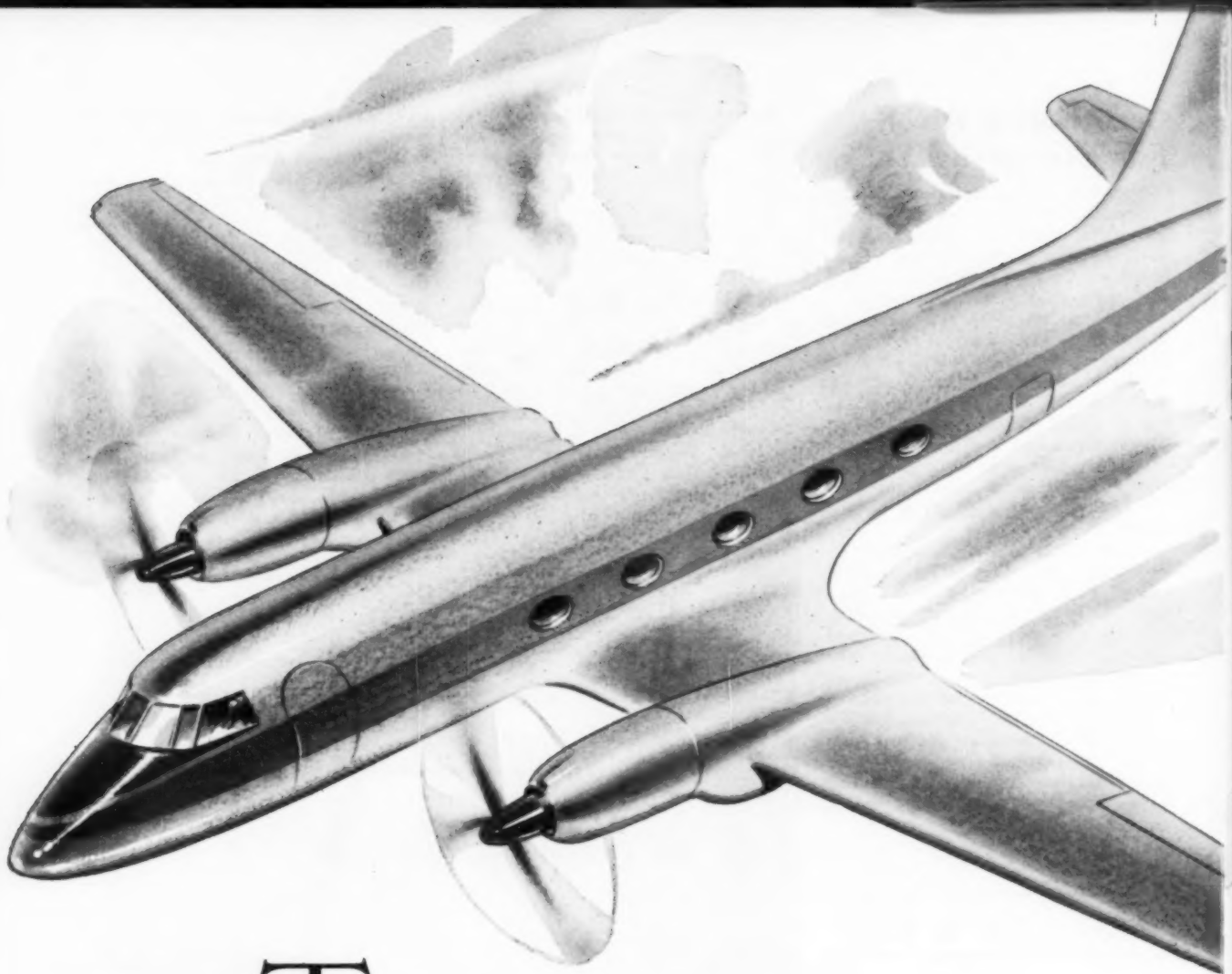
Facility is the eighth rotor test device to go into use at Kaman Aircraft. Others include those powered by both reciprocating engines and gas turbines, and facilities for running tie-down tests on completed helicopters.

Company says advantages of electric-powered test rig include:

- **Elimination** of torque variations and vibrations encountered in test rigs driven by reciprocating engines.
- **High mounting** of rotor, taking it further out of ground effect than is possible with close-coupled rig using conventional aircraft engine to power a standard helicopter drive system.
- **Ability** of electric motor to run clockwise or counterclockwise.

Another advantage, technicians said, is accurate measurement of power being applied to the rotor, achieved by measuring the current and voltage used by the electric motor. Motor also affords fine degree of rotor rpm. control and can deliver constant horsepower to rotor at any rotor speed ranging from 200 to 400 rpm.

Electric motor drives 20-ft. vertical shaft on which rotor is mounted. Test operators are housed in a reinforced concrete blockhouse equipped with window-width periscope which provides unobstructed view.



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WHO'S WHERE

(*Continued from page 15*)

Changes

Allan A. Barrie, director-aircraft sales, American Airlines, Inc. Also: **Herbert D. Baker,** director-maintenance planning and facilities (Tulsa, Okla.).

Herbert C. Langmore, manager-special products, North American Aviation's Missile Development Division, Downey, Calif.

Fred A. Klemach, senior staff engineer-missile applications, Vickers, Inc., Detroit.

Robert L. Adams, assistant manager-government products, Bendix Radio Division, Bendix Aviation Corp., Baltimore, Md.

Richard Kerney, general production manager, Chester Cable Corp., Chester, N. Y.

Thomas Bowling, director of field support-turbine engines, Continental Aviation & Engineering Corp., Detroit, Mich.

D. M. Heller and **R. E. Hiffen,** assistant general managers and **W. P. Bollinger,** director engineering, missile section-products division, Bendix-Aviation Corp., Mishawaka, Ind.

J. Nelson Lord, Jr., assistant division manager for Military, Industrial and Military Equipment Division, Allen B. DuMont Laboratories, Inc., Clifton, N. J. **John W. Lazur** succeeds Mr. Lord as military operations manager.

Canadair Ltd., Montreal, Canada, has announced the following sales division appointments: **Arthur J. Battis,** manager-parts sales; **H. J. Everard,** manager-Sabre VI and CL-41 sales; **C. D. Fairweather,** office manager; **J. H. Hamelet,** assistant to the director-commercial aircraft sales; **C. J. Heine,** New York representative; **J. J. MacBrien,** manager-missile sales; **K. J. McDonald,** assistant to the director of sales; **K. A. Miller,** manager-sales research; **E. C. V. Norsworthy,** manager-service department; **P. A. Oleskevis,** manager-special projects sales.

E. Wayne Copeland, telemetering sales manager, Pacific Division, Bendix Aviation Corp., North Hollywood, Calif.

Fred A. Schubert, superintendent-contour forming division, the Cyril Bath Co., Solon, Ohio.

Thomas Nugent, sales representative (Burbank, Calif.), United Aircraft Products, Inc., Dayton, Ohio.

Warren P. Turner, special assistant to the vice president, High Energy Propellants Division, Olin Mathieson Chemical Corp., New York, N. Y.

R. J. Norton, manager-special accounts, RCA Victor Company, Ltd., Montreal, Canada.

Richard A. Shaw, chief engineer, Neff Instrument Corp., Pasadena, Calif.

John S. Leigh, chief engineer, National Aeronautical Corp., Fort Washington, Pa.

G. K. Willecke, director of research, newly established research department, Miller Electric Manufacturing Co., Inc., Appelton, Wisc.

E. A. Bellande, in charge of foreign operations and support services, the Garrett Corp., Los Angeles, Calif. Mr. Bellande is a vice president of the company.

Paul Rodriguez, assistant general manager, Norman Larson Co., Van Nuys, Calif.

11-29

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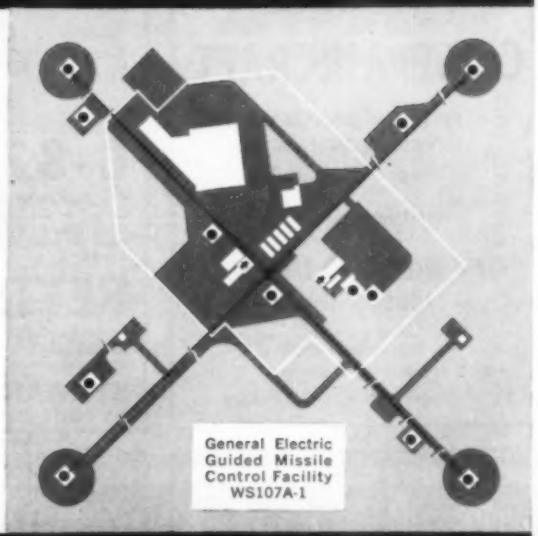

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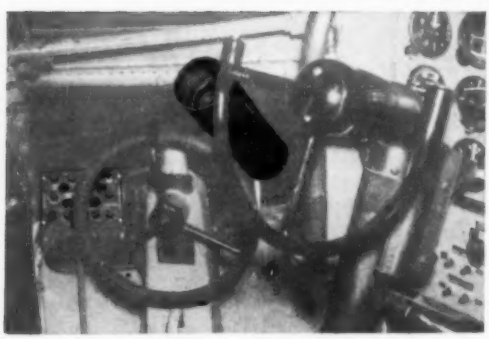

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LETTERS

Working Force

It was somewhat of a surprise to many of us here to read in the Feb. 3 (p. 23) issue of AVIATION WEEK, in connection with the development of the Polaris powerplant, that ". . . Aerojet-General's Solid Rocket Plant, which is developing the solid propellant propulsion system, has expanded from a nucleus of five in 1956 to a present working force of over 700." The fact is that the expansion from five to 700 referred specifically to the Polaris group and not to the Solid Rocket Plant as a whole. The Solid Rocket Plant, which has been in existence since 1951, actually has a working force of 2,631. Total Aerojet personnel at Azusa and Sacramento is in excess of 11,000 and we are adding 1,000 more before June.

GEORGE E. PELLETIER
Director of Public Relations
Aerojet-General Corp.
Azusa, Calif.

Make It Known

I would like to take this opportunity to congratulate Dr. Wernher von Braun and his staff on the successful launching of the first U. S. satellite, thus saving some face for the U. S. A satellite which should and could have been up a year or two ago. The American people now can re-enter their day dreaming bubble, and return to slumberland after having been half awakened by the two Russian satellites.

It must be apparent by now to others what lack of leadership, stupid political blunders and advice from "overnight missile experts" have done and could do to this country. You cannot run the U. S. with three presidents: Sherman Adams, James Hagerty and the vacationing-golfing Eisenhower who is last and less important.

With evidence pointing to the 45 cent dollar, high cost of living and increase in unemployment, this country will not coordinate its missile program which will cost less and assure a superior defense and offense.

Also, it should be evident to some that it is this country that cannot afford peace. Any steps toward peace would increase the unemployment situation and shatter the economy and prosperity of this country, which is based strictly on the war threat. Direct evidence of this is shown when a state whose unemployment reaches an alarming proportion sends representatives to Washington to obtain more defense contracts. A solution, yes, but more so showing that this country is sick and declining rapidly under three presidents, too many "know it all" generals and admirals, and lying politicians.

1958 and 1960 are election years, and time for enough propaganda to make anyone sick. Some will vote and others will continue to sleep. The characters elected will not be men of wisdom, but you don't have much choice.

In all probability, you can make these characters give you a coordinated or better missile program and economy if you make it known that you and not a big business or a political party are the government of the U. S.

In parting I would like AW to find out what happened to the report sent to Washington by the Space Flight Committee of the American Rocket Society, such as in whose wastepaper basket was it filed. Thank you.

EDWARD H. TRASKO
West Hartford, Conn.

Aviation Week welcomes the opinion of its readers on the issues raised in the magazine's editorial columns. Address letters to the Editor, Aviation Week, 330 W. 42 St., New York 36, N. Y. Try to keep letters under 500 words and give a genuine identification. We will not print anonymous letters, but names of writers will be withheld on request.

Teacher-Engineer

The series of letters that you have received on the subject of the proper utilization of engineers seems extraordinary to me.

I am the chairman of a university mechanical engineering department. We have graduate students and first rate research in progress, and would be very glad to employ a suitably qualified engineer who wishes to advance professionally and is not afraid of the hard work associated with teaching.

JOHN O. OUTWATER
Chairman
Department of Mechanical Engineering
The University of Vermont
College of Technology
Burlington, Vt.

Necessary Stimulus

In reply to the letter by James Rarick in the Dec. 30 issue (p. 102), I certainly want to be counted among those sharing Mr. Rarick's sentiment.

I have written a letter already to my Congressman, and I hope this letter by Mr. Rarick will be the necessary stimulus to get a real program going to improve the plight of the engineer.

I can't for the life of me understand why the Engineering Council for Professional Development hasn't entered the scene.

Cheers to Mr. Rarick—let's all climb on the bandwagon before it's too late.

ROBERT D. EVINS
Joplin, Mo.

Practical Solution

For several years I've been subscribing to your magazine, and feel that it is one of the finest edited, regardless of type.

But, I think you are not perfect, to me, in one respect—comparison. For instance, the Jupiter-Thor controversy. It would be easier for readers to check out a list of advantages, disadvantages, weights, production status, etc., right along side each other, rather than look them up in several issues scattered over many pages. The coverage is excellent, just hard to align.

More interesting to me, at least, would be direct comparison of Russian and American aircraft types. For instance, in the Jan. 20 edition you give a short analysis of the Sukhoi Fishpot (p. 38). I know there is more data available, but more important how does it stack up against its American and European counterparts? Moreover, which are its likely opponents? The F-104 is a day fighter, the F-106 an interceptor, the F-101 an escort fighter, the F8U (-3 in particular) a Naval counterpart, the P. 1B a European counterpart. Vice versa, which is the F-105's Russian counterpart? What are the differences between the F-105 and the F-107? Are European models comparable?

These are questions the readers would like to see answered. Can you find a practical solution?

TOM RATH
Pasadena, Calif.

AW's job is to report the facts. The readers make their own comparisons and judgments.—Ed.)

High Caliber

Re the "El Paso Taxpayer" letter (AW Dec. 23, p. 102), as an ex-Civil Service employe now working in private industry, I take exception to the tone and content of his remarks.

I worked for nearly 20 years with the National Advisory Committee for Aeronautics, a Civil Service organization, and during that time I became thoroughly acquainted not only with my own organization but with representative scientists and engineers from many other government research, testing, development and regulatory agencies, including Navy Bureau of Aeronautics, Redstone Arsenal, Civil Aeronautics Administration and others.

Almost without exception these personnel were high caliber men, well qualified technically, hard working, and generally underpaid by industry standards.

As for their not being suited to hold down corresponding jobs in industry, that idea must evoke hollow laughter from Civil Service supervisors who have seen their staffs lured away by more lucrative offers from private industry, which obviously feels that these people are competent.

Also, the question "Why were these people ('non-essential' employes) recruited in the first place. . . ?" is pointless. Anyone can become non-essential if the work load drops or there is a shift in emphasis to another type of work.

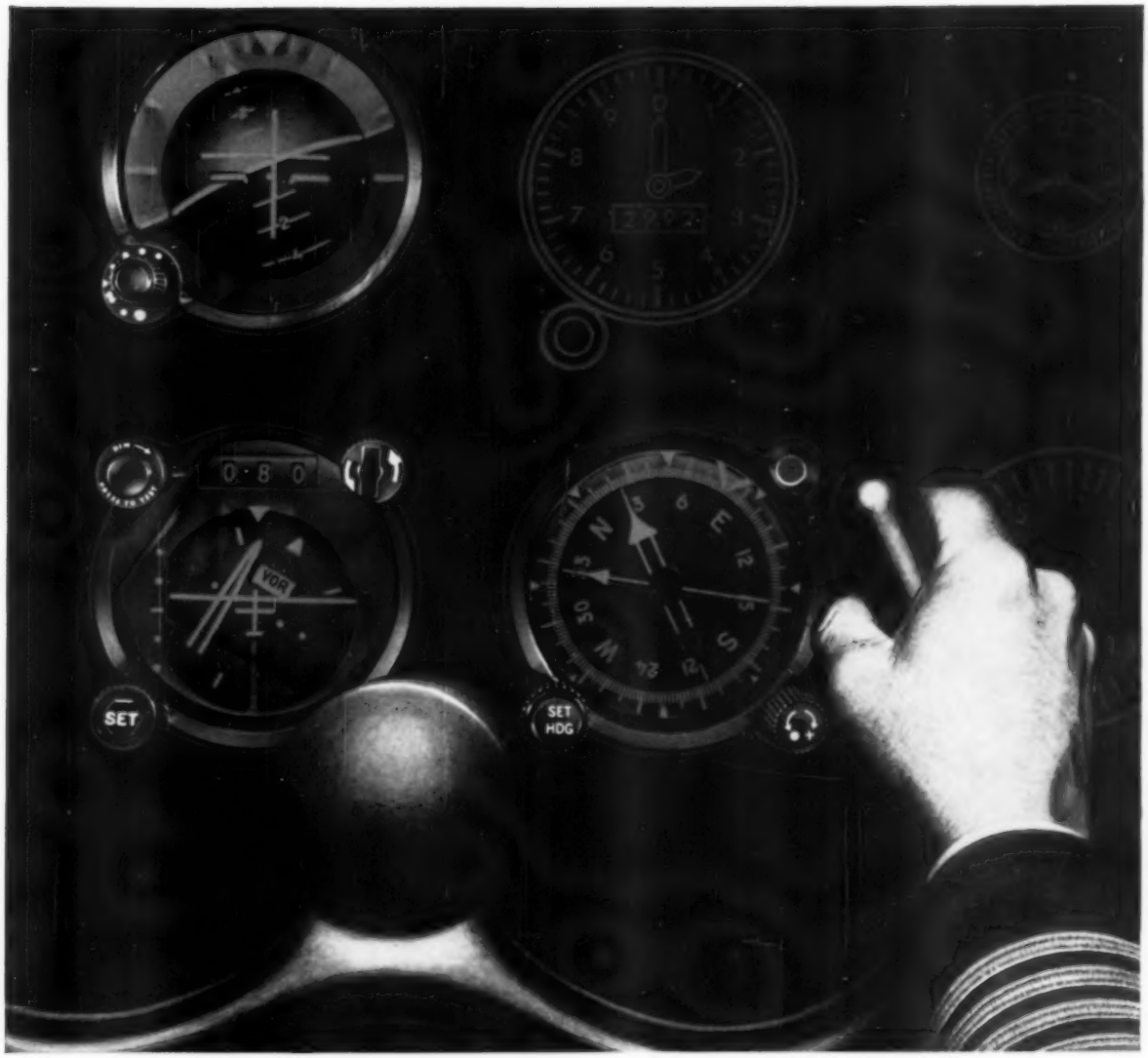
It doesn't follow that they were non-essential when they were hired.

Thousands of qualified engineers in the aviation industry have recently found themselves "non-essential" due to cutbacks and stretchouts.

Granted that there are some incompetents and loafers in the Civil Service, it is grossly unfair to the large number of able, hard working government personnel to tar them all with the same stick.

It's easy, but inane, to glibly toss around wisecracks re "The Civil Servant" missile, etc. Let's criticize constructively—and selectively!

JOHN R. WESTFALL
Florissant, Mo.



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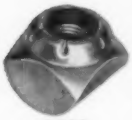

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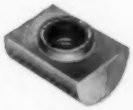

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